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CONTENTS

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PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XXIV. FEBRUARY, 1938 NO. 1

CONTENTS

EDITORIAL NOTES AND COMMENT

Our New President. Mr. Bernard H. Grehan was born September 4, 1893, in the city of New Orleans. He is the son of Bernard Grehan and Caroline Simon. His early education was obtained in the Grammar Schools, Parochial Schools and the Jesuit College in New Orleans. He received his High School education at the Jesuit College and the N. O. Boys' High School, graduating from the latter institution in 1910. He graduated from the course in Civil Engineering at Tulane University in 1915. In 1923 he received his professional degree of Civil Engineer from Tulane University. In 1918 he studied "Hull Design" at the Royal Technology College in Glascow, Scotland.

On leaving college in 1915 he was Chief of Party in charge of Topographic and Hydrographic Surveys on the Upper Tennessee River for the U. S. Engineers.

In 1916 he was principal Assistant Engineer in the office of J. F. Coleman, General Consulting Engineering.

In 1917 he went to the 1st Officers' Training Camp at Fort Logan H. Roots and later at Fort Leavenworth. He served in the World War at 1st Lieutenant of Engineers with the 312th Engineers of the 87th Division.

In August, 1918, he was sent to France with the A. E. F., returning to the United States in July, 1919, and honorably discharged from the army. He then entered the employ of George J. Glover as structural engineer. When the present company was formed in 1924, he became a member of the George J. Glover Company, Incorporated, and in 1933 was made Vice-President of that Company, which position he now holds.

He was appointed to the Louisiana State Board of Civil Engineering Examiners in the year 1925. He has served continuously and still is a member of that body.

During his college days he was a member of the Varsity Football Team for three years, receiving his letter in 1913. He was a winner of the Freshman Shield in 1911, and President of the Engineering Student Body in 1915. Member of the Phi Kappa Sigma Fraternity; Honor Fraternity; Kappa Delta Phi; and Honorary Engineering Fraternity, Tau Beta Pi. He was the President of the Louisiana Section of the American Society of Civil Engineers (1928-1929); is a member of the Louisiana Club; the Boston Club; the Executive Committee of the Alumni Association, and the Athletic Council of Tulane University.

Other Officers for 1938. Mr. David W. Godat was elected First Vice-President and Professor Boykin W. Pegues Second Vice-President for 1938. Professor A. M. Hill was re-elected Secretary-Treasurer. New Directors elected for the ensuing year are Messrs. William H. Rhodes, D. W. Stewart and B. Stanley Nelson. The other elective member of the Board is Mr. G. Glenn Cappel, who remains over from the previous administration.

Professor C. S. Williamson, Jr., as retiring President, automatically becomes a member of the Board. He takes the place thereon of the preceding retiring President, Mr. Allen S. Hackett.

The Annual Meeting and Dinner Dance. A delightful affair, indeed! Another innovation this year was the cocktail hour just preceding the dinner dance.

And what an innovation it was—truly a happy thought.

And the dinner dance itself. Dr. Douglas Anderson was toastmaster and things never lagged. What with the delicious dinner, horn tooting, balloon blowing, collapse of the speaker's table, excellent dance music, jolly men and delightful ladies, the affair was an eminent success. As is the case with all good things, it ended, but the hour was late—very late. And, Oh! that preceding cocktail hour.

New Generating Equipment at Market Street Station. One of the remarkable advances of the past few years in steam engineering has been the steady increase of working pressures and temperatures. Today, designs are made with impunity for pressures that a few years ago would have been unthinkable. Efficiencies, too, have steadily climbed to previously unbelievable heights.

The ignition internal combustion engine can no longer parade its talking point of higher efficiency and on this point even the Diesel engine must look to its laurels.

A local example of modern high pressure installation is described elsewhere in this issue by Mr. K. P. Kammer, Efficiency Engineer for the New Orleans Public Service Inc. Mr. Kammer presented his paper at the annual meeting. It is quite illuminating and makes interesting as well as instructive reading.

The Tulane Stadium Addition. We are pleased to print in this issue a paper presented by an engineering student. This paper by Mr. J. S. Burk, senior Civil Engineering student at Tulane University, was presented at the Student Conclave during the Annual Meeting. This conclave of engineering students

from L. S. U. and Tulane has been productive of spiritual stimulation to the Society, to the students, and to the two universities. They have also produced between the two engineering student bodies a spirit of cooperative friendliness which has been valuable indeed. May these annual student conclaves always be a part of our annual meeting.

The Student Conference:

Editor, Proceedings, La. Eng. Soc.,
Tulane University.
Dear Sir:

There follows a brief account of the part taken by the engineering students in the recent Louisiana Engineering Society Convention which may be of interest to your publication.

At the 3rd Annual Convention of the Louisiana Engineering Society held in New Orleans January 7th and 8th, 1938, there were present 25 students from Louisiana State University (Baton Rouge) and 113 students from Tulane University (New Orleans). The meeting was called to order by Dean L. J. Lassalle of L. S. U. and turned over to Mr. Donald E. Jahncke, student Member Tulane A. S. M. E., and Mr. J. R. Miller, Student member L. S. U.-A. I. E. E., who presided jointly during the presentation of the following technical papers:

"Mercury Steam Power Plants," by Mr. A. J. Ferguson, Student Member L. S. U. A. S. M. E.

"The Tulane Stadium," by Mr. Jack S. Burk, Student Member Tulane A. S. C. E.

"The Reconstruction of the Simsport, Louisiana Bridge," by Mr. Carl Peterson, Student Member L. S. U. A. S. C. E.

"Increasing the Usefulness of the Slide Rule," by Mr. John Francis Vogt, Jr., Student Member Tulane A. I. E. E.

"Why Be An Engineer," by Mr. J. R. Miller, Student Member L. S. U. A. I. E. E.

It was regretted that the limited time allotted to the Student Conference did not permit discussion of these interesting and well presented papers. The Student Conference then ad-

journed to the General Meeting of the convention, which was presided over by Retiring President C. S. Williamson, Jr.

The students were present on inspection trips of the New Orleans Water Purification Plant and the Market Street Station of the New Orleans Public Service. The latter trip was extremely interesting, due to the erection of 850 pound 900 degree boilers and a 37,500 KVA turbogenerator which is now in progress. The technical sessions of the convention were also attended by the students. A total of 458 members and guests registered during the convention.

Very truly yours,

J. K. MAYER,
Committee on Student Conference.

Inauguration of President Harris. An event of outstanding interest to the South was the inauguration of Dr. Rufus C. Harris as 10th President of Tulane University.

The inauguration took place January 18. The ceremony was the culmination of a three-day celebration, during which time many learned discourses were delivered.

The engineering profession was represented by President William E. Wickenden, of the Case School of Applied Science, in Cleveland, Ohio. He delivered an address entitled "Graduate Training in Engineering and Related Sciences."

PAPERS AND DISCUSSIONS

NEW GENERATING EQUIPMENT AT MARKET STREET STATION

By K. P. Kammer *

Read before the Society at the Annual Meeting, January 8, 1938.

PART I—HISTORY

The Market Street Station of New Orleans Public Service Inc. is located on a site which has been used for the generation of electricity for the city for nearly half a century. During this period it has witnessed the trend in the development of the industry, and can boast of having housed almost every conceivable type of steam-electric generating equipment, from the earliest reciprocating engines and belt driven generators to the present modern unit which will be one of the most efficient in the country.

About the year 1888 the generation of electricity was begun at this site. Until 1900 the generating equipment was housed in two main buildings. One, known as Municipal Lighting Plant, Station No. 2, contained one 1800 horsepower and one 2000 horsepower reciprocating engine, driving, by means of a line shaft and belts, 18 125-light Brush machines, and 1 125-light Wood machine. The second, known as the Main Power Station, had three reciprocating engines driving three 514 kilowatt alternators and two 500 kilowatt direct current machines. A fourth engine was direct connected to an 800 kilowatt direct current generator. The boiler room was located immediately behind these buildings.

In 1901 a new building was erected, which eventually formed the East end of the existing turbine room. Corliss engine No. 1, with its 1500 kilowatt direct current generator, was installed, and a short time later engines No. 2 and 3 rated at 2250 kilowatts.

* Member. Efficiency Engineer, New Orleans Public Service Inc.

The next addition was a new double-deck boiler room, extending parallel to Market Street and located north of the new engine room. In the period of 1904-1906 twelve boilers were installed, rated at 900 horsepower each, and fired by means of Murphy stokers. At this time, also, the engine room was extended west, and turbines No. 1, 2 and 3 installed. These were vertical units, rated at 1500 kilowatts alternating current, but later rewound for 2500 kilowatts. A little later turbine units Nos. 4 and 5 were installed. These also were vertical units rated at 3000 kilowatts and 5000 kilowatts, respectively.

The first horizontal turbo-generator unit No. 6, a 15,000 kilowatt machine, was installed in 1916, and space was provided by extending the turbine room still farther west. A second unit No. 7, also rated at 15,000 kilowatts, followed in 1918. During this period boiler changes were also made. Two new 900 horsepower boilers No. 5 and No. 13 were installed; the Murphy stokers were removed from the boilers on the lower floor, settings were raised, and underfeed stokers installed. The boilers on the upper floor were rebuilt to burn fuel oil.

In 1922 No. 8 turbo-generator, a 20,000 kilowatt unit, was installed in place of one of the Corliss engines. Until 1924 the maximum steam pressure used was 200 lbs. and the maximum steam temperature 510°F. Unit No. 9, of 20,000 kilowatt capacity, was installed in this year to operate at 350 lbs. and 700°F. steam conditions, and Unit No. 8 was rebuilt to operate at the higher pressure and temperature. The remaining Corliss engines were removed to provide space for Unit No. 9. At this time also three boiler units, Nos. 17, 18 and 20, were installed in a new high pressure boiler room north of the existing low pressure boiler room. These units rated at 1750 horsepower were designed to burn pulverized coal and operate at the new steam conditions.

In 1926, vertical turbine units Nos. 1, 2 and 3 were removed, and a 30,000 kilowatt unit No. 10 installed. Three additional boiler units, Nos. 19, 21 and 22, rated at 2000 horsepower were installed in an addition to the high pressure boiler room. These

units were designed to burn pulverized coal, fuel oil, or natural gas. At this same time building space was provided for two future boiler units.

This was the status of the generating equipment in the station in the fall of 1936, when increased load demands indicated that additional capacity would be required to serve the system.

PART II—ECONOMIC STUDY

In the fall of 1936 a study was begun to determine the type, size, and location of equipment to be purchased for this expansion program. The purpose of this study was an attempt to obtain maximum economy, minimum investment, and greatest operating convenience, while keeping in mind the future growth of the system and particularly of this station. Several months were required to complete this study, and it follows, therefore, that only a brief description can be given here.

A decision was first made to project this study for a five year period into the future. This necessitated the calculation of economy data, for each case considered, over a five-year period from 1938 to 1942. It was anticipated that the new unit would be placed in service in the early part of 1938. It also meant an estimate of load conditions for a six-year period from 1937 through 1942.

To begin such a study there were certain basic facts available. These were: 1. That the 350-lb. system operated at a fairly high efficiency for the designed steam conditions, and should not be disturbed. 2. That the largest machine in the station is a 30,000 kilowatt unit, and regardless of the size of the new unit installed, firm capacity at this time could only be increased by 30,000 kilowatts. Firm capacity is the capacity available with the largest unit out of service.

MAXIMUM HOUR CURVE

A curve showing the maximum hourly generation by months, over the six-year period, was first prepared. On this curve was included the total station capacity and firm capacity for the winter and summer periods. By means of this curve two important facts were developed: 1st, That Nos. 4 and 5 vertical turbine units should not be removed; and 2nd, That

the unit installed in 1938 would have to be followed by a second unit in the spring of 1940 provided load increase maintained the same rate of upward trend. For this reason, in each case studied, two additions to the system had to be considered.

Although thirteen different cases were investigated, from the standpoint of economy data alone, neglecting capital investment and fixed charges, these cases can be grouped into five major classifications:

A.—1250 Lb.-925°F. 22,500 KW. superposed unit, exhausting at 200 Lb.-510°F. to existing turbine units Nos. 6 and 7.
B.—350 Lb.-700°F. 30,000 KW condensing unit.
C.—650 Lb.-850°F. 30,000 KW condensing unit.
D.—650 Lb.-850°F. 40,000 KW condensing unit.
E.—850 Lb.-900°F. 30,000 KW condensing unit.

HEAT BALANCE DIAGRAM

The first step necessary in a study of this nature is the construction of a heat balance diagram. Such a heat balance diagram may be constructed when throttle and exhaust steam conditions have been decided. If the unit is to operate on the regenerative cycle, the number and location of the bleed points must be selected, and the steam conditions at these points determined. By working through such a cycle and applying the expected boiler efficiency, the efficiency of the cycle or the heat consumption may be determined for a definite turbine load.

HEAT RATE CURVE

When the heat rate has been calculated for several different loads on the same cycle, the heat rate curve for this cycle can be plotted, and from this curve the heat rate or B.T.U. consumption can be determined for any desired load.

TIME LOAD CURVE

An estimated time-load curve is next prepared for each year during which the study is projected. The area under this time-load curve represents the kilowatt-hour generation for this particular year. This time-load curve is divided up into smaller areas, and the average load or the ordinate of each area is determined. This load is then distributed on the basis of most economical loading between the new unit and the

existing units which will be required to carry the load, and the heat rate for each unit is thereby determined. From the heat rate data available from all of the smaller blocks or areas, the total fuel consumption for the year is calculated.

INVESTMENT COST DATA

The next step in this study is the calculation of investment cost for the new equipment being considered. These costs may be divided into three major classifications:

1. Reserve accounts, which include the cost of removing equipment and preparing the site for the new addition.
2. Capital accounts, which include the purchase and erection of all equipment.
3. Non-specific accounts, which include engineering, overhead, and undistributed costs.

Retirement cost of equipment removed is also obtained, so that the difference or net capital investment is obtained. Investment cost will vary not only with the type and size of equipment being studied, but also with location, so that it becomes necessary to prepare a different set of cost data for nearly every case studied.

SUMMARY SHEET

Complete data is now available to prepare a summary sheet, summarizing all costs for each year of the five-year period. This summary gives pertinent operating data, such as station capacity, station generation and output, and average station heat rate. The next item is the annual fuel consumption, followed by the annual fuel cost. To the fuel cost is added the cost of operating labor and material, and maintenance labor and material, so that the total production cost is obtained.

The next items in the summary sheet are new capital investment, reduction in old investment, and net capital additions, so that the increase in fixed charges is obtained. The final item is the net annual operating cost, which includes both production cost and fixed charges. The sum of these annual costs gives the complete cost for the five-year period, and it is now possible to compare this case with any other case on an economic basis.

CASE SELECTED

You will note by the title of this paper that the 850 Lb.-900°F. 30,000 KW condensing unit was the final selection for the new addition to this station.

While the 1250 Lb.-925°F. superposed unit offered the greatest economy, and a slightly lower total investment, the cost per kilowatt of installed capacity was greater than that of the case selected. There were several other distinct disadvantages:

1. The size of the "topping" unit was limited to 22,500 kilowatt by the capacity of the low pressure units into which it would exhaust. 2. It meant a large investment in new equipment, the successful operation of which would depend on the reliability of two older units. 3. Severe delay in the purchase of the new equipment would have been encountered. The delay would have been necessary to obtain factory inspection on the old units, and foundation inspection for the new boiler and turbine units. 4. The next addition would have to be a 350 Lb.-700°F. unit, with its inherent lower efficiency, to limit the station to a three pressure plant.

The 850 Lb.-900°F. cycle has many distinct advantages:

1. The size of the unit is not limited as in the case of the "topping" turbine. 2. The additional capacity is obtained at a very low incremental cost. 3. The additional investment over the lower pressure and temperature cycles will pay for itself in about five years. 4. The follow up unit can be designed for the same steam conditions and inherent high efficiency, and 5. A superposed unit exhausting to the low pressure machines can be installed, when the condensing water facilities at the station can no longer be increased.

PART III—CONSTRUCTION AND INSTALLATION OF EQUIPMENT

Before going into actual details of the construction and installation of the new equipment, it is advisable to consider the heat balance diagram of this installation so that the location and function of each piece of major equipment may be understood.

Such a heat balance diagram shows the main steam leaving the boiler and passing through the superheater, and finally through the main steam piping to the turbine throttle. Steam expands through the turbine until it reaches the condenser. After the steam is condensed it is pumped back through the system to the de-aerating heater by the condensate pumps. Before reaching the de-aerating heater, however, the condensate must pass through certain turbine auxiliaries. The first of these is the turbine oil cooler, where heat is removed from the turbine lubricating oil. Next it passes through the steam jet air pump condenser, where steam exhausted from the steam jet vacuum pumps used to maintain vacuum on the condenser, is condensed and the heat picked up. The condensate next passes through the low pressure heater, and here its temperature is raised by means of steam bled from the 18th stage of the turbine unit. Its temperature is raised still further in the gland steam leak-off condenser, by steam discharged from the high pressure packing gland of the turbine. The condensate then finally reaches the de-aerator.

The purpose of the de-aerator is to remove the dissolved gases such as oxygen and carbon dioxide, before these gases can reach the boiler. The de-aerator also acts as an open heater, since it is supplied with steam bled from the 14th stage of the turbine.

The condensate or boiler feed, as it is now called, drains by gravity to the boiler feed pumps. Here its pressure is raised to about 1100 lbs. per sq. in., sufficient to force it through the remaining heaters, the economizer, and finally into the boiler drum. The remaining heaters are the evaporator condenser supplied with vapor from the evaporators, and the high pressure heater supplied with steam from the 8th stage bleed point of the turbine, and from the high pressure packing leak-off of the turbine. The boiler feed water has been heated to a final temperature of about 360°F. before it enters the economizer.

Make up water is added to the system in the de-aerator, having first been evaporated, then condensed in the evaporator condenser, and finally pumped back to the de-aerator.

This completes the main cycle of this particular unit. Steam, however, may be taken from the main steam header and passed through a temperature and pressure reducing station, to the 350 lb.-700°F. steam header. From this header, the steam may be supplied to any units operating under these conditions. This steam may be still further reduced through a second reducing station to the 200 lb.-510°F. conditions, and supplied to any of the low pressure units. This is an important feature in a unit boiler-turbine installation of this type, since a turbine outage will not necessarily enforce a boiler outage at the same time.

THE BOILER AND ITS AUXILIARIES

As previously stated in this paper, building space had been provided for two additional boilers in the 1926 extension to the station. Due to changes in the design and capacity of the new boiler unit, some changes in steel design were made necessary, as well as the installation of additional steel work to support the boiler, furnace and auxiliaries.

The principal steel changes required in the boiler room consisted of moving wind bracing located between the upper section of the boiler corner columns to a section between the firing aisle columns; changes in roof construction at the rear of the unit to support the weight of the induced draft fans and the concrete slab base; and lowering the elevation of the operating floor in front of the unit, because of burner location.

New steel was required for drum girders, supporting the upper drums and carrying the load of the entire boiler; for supporting the forced draft fan located at the top of the boiler unit; for supporting economized and air preheaters at the rear of the boiler; and for supporting water wall headers and other sections of the furnace.

THE BOILER

The boiler unit is the four drum, bent tube type designed for a maximum continuous output of 385,000 lbs. of steam per hour, and a maximum working pressure of 925 lbs. per sq. in. It is fifty tubes wide and nineteen tubes deep, and contains 20,755 sq. ft. of heating surface.

Drums are constructed by the fusion welding process, and consist of two sections of rolled plate welded at the longitudinal seams, and with the drumheads welded to each end. All welds are completely X-rayed, and the complete drum is heat treated in a stress relieving furnace, by heating to a temperature of 1150°F., holding at this temperature for the required period of time, and then allowing to cool slowly. Complete drum data is given below:

Drum	Diameter		Length	Shell Thickness	Head Thickness
Front	36 in.	30′	11¼″	3 1/32″ & 1 21/32″	1-7/8 in.
Middle	48 in.	30′	11¼″	3 31/32″ & 2 1/8″	2-7/16 in.
Rear	42 in.	30′	11¼″	3 1/2″ & 1 24/32″	2-1/8 in.
Mud	48 in.	26′	5⅝″	3 31/32″ & 2 1/8″	2-7/16 in.

Boiler tubes are hot finished, seamless, Grade "C" medium carbon steel. Connections between all parts are made by expanding the tubes into bored tube seats which have been serrated to give the maximum strength at the joint. Tubes are 3¼ in. O. D. and 0.252 in. thick.

The entire weight of the boilers is carried on the drum girders and corner columns. Upper drums rest in steel saddles fastened to the girders. The weight of the lower drum or mud drum is carried by the generating tubes. The largest drums of the unit weigh slightly over twenty tons each, and the water load of the boiler at the saturated temperature is 45 tons.

The boiler unit is the three pass type, and is baffled so that the furnace gases make three complete circuits before entering the economizer.

Steam leaves at the top of the rear boiler drum, having first passed through a steam washer, or scrubber type baffle. The purpose of this baffle is to remove entrained solids from the steam. It accomplishes this purpose by spraying the steam leaving the boiler, with the incoming boiler feed water, by means of nozzles provided for this purpose. Closely spaced corrugated plates are also provided, and the steam passing through these plates has its excess moisture removed before leaving the drum.

THE SUPERHEATER

The superheater is the single-pass, pendant type, located in the first pass of the boiler, immediately behind the first three rows of generating tubes. It contains 9,570 sq. ft. of heating

surface, is 76 tubes wide and 12 tubes deep, containing six loops. Tubes are 2 in. O. D. and 0.180 in. thick. Tubes are constructed of medium carbon steel for eight rows and chrome molybdenum steel for four rows.

Steam is supplied to the inlet header from the rear drum through seventeen 4-inch supply tubes, so arranged to give equal distribution throughout the inlet header. The steam then passes through the six loops to the outlet header, from where it leaves the boiler.

Superheater tubes do not extend across the entire width of the boiler. A small section near one side is walled off by a refractory wall, and contains no superheater tubes. A vertical damper at the top of the third pass in this smaller section allows some of the gases to by-pass the superheater, and thereby provides for a superheat temperature control.

THE FURNACE

The furnace contains 17,400 cubic feet of combustion space and is completely water cooled in the lower section. The water wall sections contain a total of 4,140 square feet of heating surface.

Water walls are designed for the Bailey stud tube construction. Side walls are partially studded over the larger portion and fully studded in the vicinity of the burners. Front and rear walls are partially studded.

Stud tube construction consists of welding short steel studs to the 3¼-in. O. D. water wall tubes. The partially studded tubes have studs welded on the side only. Over these studs is placed a plastic chrome ore refractory. The metal of the tubes on the furnace side is left exposed. Full stud construction consists of welding studs to the sides and front of the tubes. The tube is then completely covered with plastic chrome ore.

The lower section of the furnace contains the ash pit and hearth screen tubes. These tubes are covered with refractory material, but are designed for Bailey block construction, should pulverized coal be used in the future.

The upper section of the side wall is designed for sectionally supported refractory walls. In this type of wall each re-

fractory block is supported and locked in place by hangers, supported from horizontal steel members.

THE BURNERS

Six trifuel burners, capable of burning natural gas, fuel oil, or pulverized coal, are installed in the lower section of the front wall of the furnace. The burners are arranged in two rows of three each, and are completely enclosed by the windbox or plenum chamber, so that air from combustion may be supplied to the burners under pressure.

THE ECONOMIZER

The economizer is located at the rear of the boiler, and is of the continuous tube return bend type. It contains 4,000 sq. ft. of heating surface, in 2-in. O. D. tubes, 25 ft. long. It is 17 tubes wide and 18 tubes high. The economizer is designed to withstand the full boiler feed pressure of about 1,100 lbs. per sq. in.

Boiler feed water is supplied to the economizer manifold, located at the lower section. From this manifold the water passes upward through the continuous loops of each of the seventeen sections, and is finally supplied to the rear drum through seventeen 2-in. tubes, one for each section.

Flue gas leaving the boiler passes upward through the single pass economizer section before entering the air preheaters. For this reason the economizer is the parallel flow type. Heat is transferred from the hot gases to the cooler feed water. At the maximum boiler output, the gas temperature is reduced from 675°F. at the boiler outlet to about 540°F. at the economizer outlet.

THE AIR PREHEATER

Flue gas leaving the economizer divides and passes upward through two ducts, one of which leads to each of the two Ljungstrom regenerative type air preheaters. Here additional heat is removed from the flue gases, and transferred to the air supplied for combustion.

The regenerative type of air preheater consists essentially of a circular housing to which are connected air and gas ducts. Inside of this housing is contained a rotor, which is rotated

slowly by means of a driving motor. In the rotor are stacked notched and undulated plates alternately. These sheet steel plates allow the flue gases to pass through, but pick up heat from the gas. As the plates are rotated to the air side of the preheater, heat is again transferred to the cooler air. In this manner the preheater surface is alternately heated and cooled, so that heat is transferred from the gas to the air by direct contact action. Sealing strips at the top and bottom of the rotor prevent leakage from the air to the gas side of the heater.

Each air preheater contains 19,600 sq. ft. of heating surface, and at the maximum boiler output will heat the air supplied to the furnace of the boiler from 100°F. to 425°F. and reduce the flue gas temperature from 540°F to 280°F.

THE INDUCED DRAFT FANS

Flue gas leaving the air preheaters passes upward through two separate ducts to each of the two induced draft fans located on the roof of the boiler room building.

These fans are of the double inlet, vane controlled type. Each fan is driven by a 300 horsepower motor, at a constant speed of 870 R. P. M. Each fan will handle 73,000 cubic feet of gas per minute, against a total static head of 9.5 inches of water. Each fan, however, is designed with sufficient capacity to operate the boiler at 75% of maximum output, with the other fan out of service. To accomplish this the two vertical ducts below the fans are cross connected with a horizontal duct. This will allow the flue gas to be drawn through the two air preheaters, and then into a single fan to reduce the excessive friction loss which would occur if an attempt were made to pass all the gas through a single preheater.

The gas is discharged from each fan through a single outlet and then into a common breeching which leads to the stack.

THE FORCED DRAFT FANS

The forced draft fans are also of the double inlet, vane controlled type. These fans are located at the top of the boiler, immediately below the boiler room roof. Air is drawn in from the top of the boiler, and is passed downward through separate ducts to each of the two air preheaters. The air is then dis-

charged downward through ducts which pass around the side of the boiler, to a common windbox. Here the air is supplied to the burners at the required pressure.

Each fan is driven by a 125 horsepower constant speed motor at 1150 R. P. M. Each fan will handle 52,600 cubic feet of air a minute at a total static pressure of 8.2 inches of water. Each of these fans is also designed to operate the boiler at 75% of maximum output, and the ducts are cross-connected so that a single fan may be operated with both air preheaters.

VANE CONTROL

It has been mentioned above that these fans are of the vane controlled type. Since they are driven at a constant speed some means must be provided to control the quantity of air and gas handled. This is accomplished by means of movable vanes located at the suction inlets to each fan. These vanes can be remotely controlled from the fully closed to the wide open position from the boiler operating board, and position indicators are provided to indicate the position of the vanes to the operator. These vanes also accomplish the purpose of maintaining a higher fan efficiency at low outputs.

ELECTRICAL INTERLOCKING

Interlocking of the electrical circuit of fans and vanes is provided to give certain operating protection. In the event that any fan should trip out of service, the vanes on this fan will automatically close preventing recirculation of the air or gas from the fan still in operation back through the inoperative fan. In the event one induced draft fan trips out of service, the corresponding forced draft fan will automatically trip out, and the vanes on both fans will close. This is done to prevent building up a positive pressure in the furnace, with the danger of injuring the setting.

THE TURBINE ROOM

The location selected for the installation of turbine No. 11 required the erection of a new turbine room building. It had been planned to use this space for a future turbine room as early as the 1926 extension, and certain provisions were made at that time to facilitate future construction.

In addition to the new turbine room, a turbine auxiliary bay was created by the removal of two boilers from the lower floor of the old low pressure boiler room, adjacent to the turbine room, and houses such auxiliaries as boiler feed pumps, high pressure heaters, evaporators, etc.

Piling was driven on 30-inch centers under the complete turbine room area to various depths, depending on the required basement elevation, and the thickness of the concrete mat at the particular location. Piling ranged in length from 70 feet to 40 feet, and was designed to carry loads ranging from 20 tons for the larger piling to 12 tons for the shorter piling. Considerable excavation was necessary before the concrete mat could be poured. The lowest point of excavation was immediately below the intake well, to a depth of about 34 feet below ground level.

The concrete mat under the turbine room consists chiefly of four principal sections: (1) The section under the turbo-generator pedestal, which was poured to a thickness of 15 feet in the area surrounding the circulating water discharge pipe and to a thickness of 6 feet in the remaining area; (2) The circulating water intake well section; (3) The section surrounding the intake well; and (4) The section supporting the north wall columns poured to a thickness of 6½ feet.

The greater portion of the turbine room basement area is at elevation 24.0′, or about thirteen feet below ground level. Other elevations were required to tie-in the new mat with the existing mats on three sides. These were the new boiler room mat at elevation 35.5′, the old boiler room mat at elevation 34.0′, and the new electric bay mat at elevation 30.0′.

The north wall of the electric bay serves as the south wall of the new turbine room. This wall, which was erected on the 1926 extension, had its steel columns designed to carry the traveling crane rail, and support the new turbine room roof trusses. It was only necessary, therefore, to provide new steel for the north turbine room wall and the west temporary end wall, the roof trusses and roof flooring. Additional steel was required to tie in the new building with existing buildings, and for platforms, walkways, and to support auxiliary equipment.

The turbo-generator load is carried on a concrete pedestal or foundation 36 feet high, extending from elevation 24.0′ to elevation 60.0′. About 400 cubic yards of concrete were required for this pedestal, and some 40 tons of reinforcing steel.

A brick wall separates the boiler room from the new turbine room. Provisions were made in the foundation mat and the intake well for future circulating water connections to unit No. 12. Other equipment contained in the turbine room consists chiefly of the condenser, circulating pump, hot well pumps, de-aerating heater, distilled water tank, low pressure heaters, and hydrogen cooling apparatus.

THE TURBINE

The steam turbine is designed for a maximum continuous capacity of 37,500 kilowatts when supplied with steam at 850 lbs. pressure and 900°F. This unit operates at 3,600 R. P. M. and contains 21 stages.

Steam is supplied from the throttle to the steam chests of the unit and then through multiple type control valves, to various segments of the first stage nozzle ring. The first stage is a Curtis type wheel, containing two velocity stages on a single wheel, with intermediate nozzles. The steam expands through the remaining stages of the high pressure section, and is then exhausted to the low pressure section of the unit. This low pressure section consisting of the last three stages, is designed for a double flow arrangement. Steam entering this section divides and enters the nozzles in opposite directions before being exhausted to the condenser. The purpose of this double flow arrangement is to reduce the diameter of the wheels and, therefore, the peripheral speed for this high speed machine.

The high pressure shaft packing is provided with two leak-off sections, one of which exhausts to the 8th stage heater, and the other to the gland leak-off heater. Three sets of water-sealed low pressure shaft packing are provided. The turbine rotor is supported by three main bearings.

The turbine oil base, or reservoir, is located below the front end of the machine. It contains the oil pumps, oil coolers, and hydraulic valve operating mechanism. All oil pressure

parts are completely enclosed, and oil supply piping is installed inside of the return piping to eliminate the oil fire hazard.

The turbine is direct connected to, and serves as a prime mover for the 37,500 KVA hydrogen cooled generator.

THE HYDROGEN COOLED GENERATOR

In a hydrogen cooled generator, hydrogen gas instead of air is used as the medium by which heat is removed from the generator windings. The principal advantages of the use of hydrogen are lower windage losses, especially in high speed machines, and more effective protection of generator coils and insulation.

In the hydrogen cooled generator, the four hydrogen fin-tube coolers are located inside of the generator housing and for this reason there are no external ducts or coolers. Forced circulation of the gas is provided for by means of fans located at each end of the generator rotor. The gas first passes through the windings where its temperature is increased, and then through fin-tube coolers where heat is conducted to the cooling water, and the gas brought back to its normal temperature.

To prevent the escape of hydrogen at the point where the shaft passes through the housing, oil seals are provided. These seals are located in the main generator bearings, and the bearings form a part of and are supported by the generator end shields or end bells.

Oil is supplied to the bearing seals under pressure by means of a separate oil circulating pump. Oil draining back from these seals is impregnated with hydrogen, and flows first to the hydrogen detraining tank and the vacuum tank where the hydrogen is removed before the oil is recirculated. Provision is also made so that oil may be supplied from the main turbine oil pump, upon failure of the hydrogen seal pump.

Hydrogen make up is supplied continuously to the generator to replace the gas lost by absorption in the seal oil, or by leakage through machine casing. This make up is controlled automatically by a solenoid valve operated from the machine gas pressure. When the gas pressure in the generator drops below 8 inches of water the valve opens and admits hydrogen from the supply tanks.

pipes are fairly well balanced. This arrangement resulted in a saving estimated at about $90,000.

THE BOILER FEED PUMPS

A new type of boiler feed pump is being used on this extension. This is a six-stage volute type pump instead of the diffuser type pump, generally found in pumps of multi-stage design. It really consists of six volute pumps in series, mounted on a single shaft and contained in a single casing.

Water enters the pump to the suction of the first stage impeller which is mounted at one end of the shaft. The discharge from this impeller or pump is piped below and outside of the casing to the suction of the second stage impeller located at the opposite end of the shaft. This process is continued through successive stages, until the water is finally discharged from the pump at the center, at the desired pressure.

There are many advantages attached to this type of design. The discharge or the high pressure stage is at the center, and the two lowest pressure stages at each end. It is, therefore, necessary only to pack against suction pressure on one end, and first stage pressure on the other end, where the shaft extends through the casing. High pressure packing glands, breakdown chambers, and balancing drums are entirely eliminated. There are three impellers on each side of the center line of the pump, and these impellers are so arranged opposed to each other that the pump is axially balanced. By having the stages alternately discharge upward and downward, improvements in radial balance are also obtained. The simplicity of design of the rotor allows for quicker assembly and reduced maintenance.

Three such pumps are installed in connection with this installation. Each pump is designed for a maximum capacity of 200,000 pounds of water per hour against a discharge pressure of 1,100 pounds per square inch. They are designed to operate at 3,600 R. P. M. and two of the pumps are driven by 500 horsepower constant speed motors, while the third is driven by 450 horsepower hydraulically governed steam turbine.

HIGH PRESSURE HEATERS

When a heater is operated under a very high working pressure on the heads and tubes, a large number of very heavy bolts are required to secure the covers and provide sufficient gasket pressure. For instance, a heater having a water box 3 feet in diameter and operating at a working pressure of 1,100 pounds per square inch would exert a total force against the cover of 1,200,000 pounds.

Manufacturers of closed heaters have overcome this condition by various methods. The high pressure heaters furnished on this extension are of the "breech-block" design. In this type of design the head covers for both the stationary and floating heads have lugs machined in the outer periphery of the cover. Similar lugs are machined in the inner circumference of the head. When the cover is inserted and revolved a few inches, the projections engage each other, and the cover is locked in position. Two concentric rings are then slipped over the stud bolts, with the gasket underneath. These bolts are of light construction sufficient to seal the gasket.

In this type of construction, the water boxes are machined out of a solid steel forging, and the tube sheet is an integral part of the water box. Inlet and outlet nozzles are also machined from solid forgings and are welded both internally and externally to the water box. These nozzles are flanged to allow removal of the tube bundles and water boxes as a unit. The heaters are set in the vertical position and an overhead crane is provided to remove tube bundles.

PIPING AND VALVES

High pressure piping is designed for the use of welded construction almost entirely. This design is also followed to a large extent on the medium and low pressure piping. Flanged joints are used wherever it is necessary to remove equipment from the line for inspection or maintenance.

Carbon-Molybdenum steel is used entirely in fabricating the high pressure, high temperature piping. The end of the tubing is machined to form the welding groove, and the two ends of the tubing are butted together, with a chill ring between them. This forms a solid groove into which the welding bead is applied. In the case of a welded joint between the tubing

and a valve, the end of the tubing is upset to the same metal thickness as the valve body. Tubing and valve body is then machined to form the welding groove. In this case the tubing and valve body is counterbored so that the chill ring fits flush with the inside of the piping.

On high pressure low temperature services, such as boiler feed lines, medium carbon steel tubing is used. On the larger sizes of piping the use of chill rings is also employed. On the smaller size piping, the ends of the tubes and valve bodies are simply machined back at an angle to form the welding groove, butted together, and the welding bead applied. All welds are stress relieved by heat treating the welded joint.

No X-raying of piping welds is employed on this erection job. Instead an "Aeronograph" is used to check the method by which the weld is applied. The Aeronograph is a recording instrument which records the current flow across the electrodes, and by this means a record of the welding procedure is obtained.

Valves for the high temperature, high pressure service are of especially heavy and rugged construction, and employ the use of special steel alloys. Valve bodies and bonnets are constructed of carbon-molybdenum steel. Stellited seats and discs are used for the most severe services, and either nitralloy or stainless steel seats and discs for less severe services. All large valves for the main services will be motor operated. A twelve-inch motor operated valve requires an overall clearance of over nine feet and weighs slightly over 3½ tons.

EFFICIENCY DATA

The boiler unit is guaranteed at the maximum steam output, for an overall efficiency, including economizer and air preheater, of 84% when using natural gas as fuel. With oil as fuel the guaranteed efficiency is nearly 88%.

The overall heat rate of the cycle, based on a constant boiler efficiency, varies with the load on the turbine unit, and reaches a minimum at about full load. At this load of 37,500 kilowatts, and with a back pressure of 1.4 inches of mercury which represents the yearly average, the estimated heat rate is 11,820 B. T. U. per kilowatt-hour net output.

The heat rate given above is comparable with a heat rate of 15,500 B. T. U. per kilowatt-hour net on unit No. 10, up to this time the most efficient unit in the station, and represents an improvement, therefore, of approximately 24% over the best previous heat cycle.

SUMMARY

In summarizing all of the foregoing data, it is believed that the initial objectives of this expansion program have been fully realized. A boiler-turbine unit has been obtained which should be reliable and serviceable, well beyond the range of experimentation, and at the same time highly efficient. This capacity represents low investment and high return for capacity to meet the needs of this system, and to function with existing equipment. Future growth has been provided for in a manner that will allow for the maximum development of this site, which is to a large extent limited by existing condensing water facilities.

THE TULANE STADIUM ADDITION

By Jack S. Burk *

Read before the Student Conclave Annual Meeting, January 7, 1938.

In selecting the subject of this brief paper, it was thought best to take one of general interest to students: something which would fall within the range of their experience and, if possible, a subject which would embrace economic features as well as those more strictly of a technical nature. Almost everyone, some time in his life, has had occasion to sit in and become acquainted with a stadium. Accordingly, I am submitting for your consideration some things in connection with the addition to the Tulane Stadium, recently completed and utilized in both the Tulane-L. S. U. and Sugar Bowl games.

Originally the Tulane Stadium consisted of extensive wooden bleachers, holding possibly 10,000 people, and built safely, but none too scientifically, by the Association of Commerce when President Taft visited New Orleans years ago. After these served their usefulness, the University, through the generosity of the people of New Orleans, built their first concrete stadium, accommodating possibly 15,000, and containing many rooms and other facilities essential to track and field events. By 1917, the attendance had increased in such measure that additional wooden bleachers were constructed. These bleachers were scientifically designed, were built of cypress, and have served their purpose to the present day. They seat approximately 8,000 people at an initial cost of about $4.50 per seat. These wooden stands were supported on spread footings of reenforced concrete.

The present stadium is of typical concrete construction, supported on plain piles, cut off at about the water table. It was designed by Emile Weil at a cost of approximately $300,000. It accommodated 23,000 people, fixing the cost per seat at about $13.00, or three times that of the wooden stands.

* Senior Civil Engineering Student, College of Engineering, Tulane University.

The present addition to the stadium cost about $145,000, exclusive of the extensive work done by the city, through the whole-hearted co-operation of the Mayor, Mr. Robert Maestri. The city went to considerable expense to construct roads and parking space to the rear of the structure. The complete plot plan was laid out by Professor Fox with the assistance of the students in his surveying classes. The addition was built of structural steel and provides for the seating of about 14,500 fans. The estimated cost per seat is $8.25, as compared with $13.00 per seat of the existing stadium. The price of $145,000 quoted before included the paving of walks and many other extras; therefore, it could not be used to compute the cost per seat.

From the foregoing discussion, it may be seen that the University has made use of three types of construction, namely, timber, re-enforced concrete and structural steel.

Why should structural steel be used for an extension to a concrete stadium? This is a question well worthy of consideration. Moreover, it is one which has been long discussed by Orleanians, as they are always interested in the University affairs, and especially interested in its athletic facilities. The selection of structural steel was dependent entirely upon the factors of time and finance, as I shall attempt to show.

It would have been natural to construct this addition of re-enforced concrete of the same design as the existing stadium. To have done this would have cost about $240,000 and would have necessitated more time for construction than was available. The advantage of such design would have been the continuity of design, and the production of a more homogeneous mass. It would have been more desirable from the standpoint of appearance and architectural treatment. The maintenance charges would have been low, because the knowledge of re-enforced concrete and the art of construction has progressed to such a point that many of the features which heretofore resulted in maintenance charges would have been eliminated.

Seemingly, if there had been sufficient time, a re-enforced concrete addition would have appealed to the public as more

desirable. The disadvantages would have been primarily the cost per seat, estimated at $16.50, as compared with the steel construction estimated at $8.25 per seat. The time available for construction was limited, as it was essential that the seats be available for the Sugar Bowl game of January 1st. Moreover, it was desirable, from the standpoint of occupancy for the Tulane-L. S. U. game, because that game always taxes the seating facilities to the utmost. In fact, this feature of availability may have been considered the controlling influence. I may add at this point that the prompt delivery of the steel and the high efficiency of the contractors, Doullut & Ewin, made possible the completion of the stadium for the L. S. U. game, thereby securing a revenue which otherwise would have been lost, and it seems that such returns should be charged off against the first cost. Thus, we can see that the chief advantages accruing from the use of such construction were: Availability in the allotted time and a materially lower cost as compared with concrete construction.

While it is true that a properly designed timber structure treated with preservative materials might have secured a comfortably lower cost, it would not have been completed at any earlier date and aesthetic conditions excluded its use.

The stadium addition was made possible by the Mid-Winter Sports Association working in conjunction with Tulane University. The first conception of the addition as constructed by the combination is brought forth in a letter to the Tulane Board of Administrators from the Mid-Winter Sports Association as published in The Times-Picayune. Quoting therefrom:

> "The inaugural Sugar Bowl game was made possible by the civic minded action of yourselves in allowing us free use of your stadium, a custom which you have continued to the present time and for which we will always be deeply grateful.
>
> "It must have become apparent to you that the kind of crowds that we are drawing are overtaxing the stadium, and that the building of temporary stands to accommodate them is uneconomical as well as failing to supply the demand."

Further on it is stated:

"Undoubtedly the present seating capacity of Tulane Stadium is sufficient for Tulane's own needs and we cannot fairly, therefore, ask any expenditure of funds on its part for that which it does not need unless we can assure them a fairly safe method of re-payment of these funds with interest.

"We feel that this Association can safely undertake to reimburse you the sum of $20,000 per year, over a period of years, for such amount, with interest, as you might be willing to expend, in constructing additional seating capacity."

Tulane's reply was favorable, thus formulating a pact which was to produce the long desired stadium addition.

Much time was given to considering the type of construction, for the selection of structural steel or re-inforced concrete was a prime factor in the design. Structural steel was employed for reasons as stated previously.

The first design of the architects followed the arc of a circle as proposed at the construction of the concrete stands, affording ample space for a track surrounding the gridiron. This made possible a simplified design following the same general treatment of the existing structure. However, the consideration of a track was discarded and Tulane asked to have the structure brought in closer to the playing field. This proved to be a very troublesome feature. To move the stands inward necessitated flattening the arc while keeping the ends tangent to the existing stadium.

After thoroughly surveying the problem, the architects devised a flat, several-centered curve which fulfilled the requirements of position, but which caused considerable trouble in the tier dimensions. The end section was wider than the mid-section, causing a variation in the treads and risers of the decking, and producing a design which failed to realize its maximum economy by duplicating the steel work and reducing detailing costs.

Spread and pile foundations were considered; piles being more expensive but producing by far a superior foundation. The soil conditions showed the tendency of spread footings to sink, thereby making the pile foundation with higher first cost

the least expensive over a period of years. Creosoted piles were used in the construction mainly because plain piles had to be cut below the water line, necessitating more excavation and an increased quantity of concrete work.

The design of stringers was quite an interesting problem. They had to be fashioned in such a manner as to allow complete view of the gridiron from each and every seat. To do this, they were broken into four distinct slopes, rising to the rear of the stadium. The slopes required were determined by sight lines drawn from the field to the seats, insuring the proper visibility.

The completed plans and specifications were given out for competitive bids. The contractors submitted base bids plus alternates of different designs following the architects' general design. Doullut & Ewin proposed an alternate with the Virginia Bridge Company, which was accepted. It was the same as the original design, except that the ramp construction and the curves were changed. A simplified three-centered curve was used facilitating the production and installation of the deck plates. One line of columns was replaced by truss-work from which was hung the horizontal portion of the ramp. The cost of this structure was approximately $145,000 with a capacity of 14,462 people. The structure was designed from the A. I. S. C. specification for a front to back sway of 22 pounds per seat, a side to side sway of 12 pounds per seat and a live load of 100 pounds per square foot.

The foundation was composed of creosoted piles, concrete pile caps and concrete piers. The piles were tested singularly and in groups. Six test piles were driven determining the use of 40-foot piles to produce the required strength. No definite bearing strata was reached; however, they obtained enough bearing and frictional strength to uphold the column load. The piles were spotted from arbitrary base lines produced to the front and rear of the structure. Concrete pile caps were constructed four feet below grade, upon which were poured the piers extending to 18 inches above grade. The elevation of the pier tops was established from an assumed elevation for the lower walkway of the existing concrete stadium. In an

effort to secure the utmost precision, the anchor bolts were not cast in the pier heads, but grouted in with transit alignment.

The columns were bolted directly to the piers and support the stringers plus part of the ramp. The stringers are Carnegie beams except to the rear where they serve as the upper chord of the truss substituting for the missing column course. They are broken into four distinct slopes, as previously stated, and extend from a four-foot overhang on the rear columns to a concrete chain wall in front of the structure, where they are anchored. The lower ends of the stringers are bolted to angles that are cast into the concrete wall.

The ramp rises from both ends to the central portion of the stadium, where it follows horizontally the curve of the structure to the eight openings into the deck. The rising portion of the ramp is supported on columns, while the horizontal portion is hung from the trusses. It is a four-inch, re-inforced concrete slab, and was figured for a higher live load than the decking.

The steel decking is composed of 3/16 inch steel plates bent in the shape of an "L", forming treads and risers. At the end of the treads small lugs were shop welded for interlocking the plates and straps were welded to the ends for connection to the supports. These straps were bolted to the stringers. The plates were stepped up the stringers, each one locking with butt hiding the connection of the one immediately below it. The seams were welded only to make the deck watertight, as it was not essential to the strength of the plates. Steel seat brackets were welded to the deck plates and the wood seats were carried thereon.

All the structural steel work under the stands, not including the undeside of the steel decking, received a shop coat of red lead, and after erection, an additional coat of graphite paint. All points of contact between steel and steel received an extra coat of red lead in the field. All parts that were welded were shipped from the plant without paint. After construction, the top of the deck was wire brushed, cleaned thoroughly and given two coats of steel deck paint, corresponding as closely as possible to the color of the concrete portion of the stadium. The underside of the decking was given two coats of graphite

paint. It is estimated that the maintenance cost of painting will be approximately $500.00 per year.

The upper deck is provided with two one-inch expansion joints.

We must give credit where credit is due, so I think it is entirely proper that I submit the names of those responsible for the construction of this stadium.

The associate architects were Moise H. Goldstein and Herbert A. Benson. They retained Mr. Jens Brae Jensen as engineer. The contractors were Doullut & Ewin. Professor Donald Derickson served as advisory engineer to the Tulane Board of Administrators.

MEMBERSHIP LIST

C. M. : Charter Member
H. M. : Honorary Member
L. M. : Life 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

MICHAEL C. ABRAHM, (1936). Engineer, New Orleans Public Service Inc., 317 Baronne St.

JAMES R. ADAMS, (N. R.), (1911), ssistant 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, 830 Audubon Bldg., New Orleans.

ALBERT S. ANDERSON, (1937), Electrical Engineer with New Orleans Public Service Inc., 317 Baronne St., New Orleans.

DOUGLAS S. ANDERSON, (H. M.), (Jan. 1, 1909), Professor Emeritus of Electrical Engineering and Dean Emeritus 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, (1930), Assistant Engineer, U. S. Engineers, 2nd N. O. District, foot of Prytania Street, New Orleans, La.

MARSHALL BALLARD, JR., (Aff. M.), (1937), 605 United Fruit Bldg., New Orleans.

CHARLES CLIFTON BARNARD, (N. R.), (1937), Junior Engineer on Construction, Minden, La. (Present temporary address: 1603 Broadway, 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.), (1929), 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.

BENNETT B. BATTAILE, (N. R.), (1937), Draftsman, Fairfield Wire Works, Tennessee Coal, Iron & R. R. Co., Fairfield, Ala., 5106 Overlook Pl., Fairfield, 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.

C. J. BEDELL, (1936), Chief Engineer, New Orleans Public Belt Railroad, 502 Pine St., New Orleans.

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DEWITT L. MORRIS, (N. R. J.), (1937), Mechanical Engineering Draftsman, Port Sulphur, La.

WALTER B. MOSES, (1912), Consulting Engineer, 425 S. Peters St., New Orleans.

CARL MUENCH, (1927), Vice-President, Charge of Engineering Construction and Operation The Celotex Co., Box 26 Marrero, La.

JACOB F. MULLER, JR., (1932), Vice-President, Muller Furniture Mfg. Co., No. 3 Fairview Court, New Orleans.

CHARLES A. MYERS, (N. R.), (1937), Structural Engineer, Louisiana Highway Commission, Baton Rouge, La.

HU. B. MYERS, JR., (1929), Civil Engineer, 1028 Nashville Ave., New Orleans.

EDWARD M. NABERSCHNIG, JR., (1923), Assistant to Works Superintendent, Southern Cotton Oil Co., Box 369, New Orleans.

CLAYTON L. NAIRNE, (1929), with New Orleans Public Service Inc., 317 Baronne St., New Orleans.

ROBERT L. NALL, (1936), Engineer, Flintkote Co., 730 Dumaine St., New Orleans.

ARTHUR A. NAQUIN, (1924), Superintendent of Schedules, New Orleans Public Service Inc., 7445 Maple St., New Orleans.

ALLEN J. NEGROTTO, (1920), Regional Engineer, Works Progress Administration, 4037 Banks St., New Orleans.

BERNARD STANLEY NELSON, (1911), Chief Engineer, A. M. Lockett & Co., Ltd., 501 Queen and Crescent Bldg., New Orleans.

WALDEMAR, STANLEY NELSON, (J.), (1936), Draftsman, 7319 Panola St., New Orleans.

LEROY L. NEWMAN, (1923), Superintendent of Distribution, New Orleans Public Service Inc., 317 Baronne St., New Orleans.

WILLIAM T. NEWTON, (1915), Senior Superintendent, U. S. Engineers, 1206 Short St., New Orleans.

J. CHRIS NIELSEN, JR., (J.), (1933), Surveying (Transitman), 2118 Dublin St., New Orleans.

F. A. NOBILE, (N. R. J.), (1937), Architect, 19 Atlas St., Akron, Ohio.

C. B. NORRIS, (1936), Asst. Prof. Electrical Engineering, Tulane University, 1312 Fern St., New Orleans.

CECIL K. OAKES, (1937), Civil Engineer, U. S. Engineer's Office, Foot of Prytania St., New Orleans.

WILLIAM F. OAKES, (1918), General Contractor, 344 Camp St., New Orleans.

BERNY OAKLAND, (N. R.), (1934), with La-Del Oil Properties, Inc., 603 Ouachita Bank Bldg., Monroe, La.

CHARLES W. OKEY, (N. R.), (1911), Principal Engineer, Tennessee Valley Authority, Knoxville, Tenn.

H. N. OLD, (1935), District Engineer, U. S. Public Health Service, Marine Hospital, New Orleans.

OLE K. OLSEN (L. M.), Contracting Engineer, 823 Perdido St., New Orleans.

JOHN H. O'NEILL, (1916), Sanitary Engineer, Director Bureau of Sanitary Engineering, Louisiana State Board of Health, 637 Lowerline St., New Orleans.

WILLIAM P. OSTER, (1928), Sales Engineer with Equitable Equipment Co., Inc., 4651 Baccich St., New Orleans.

PASCAL PARETI, JR., (1933), Engineer, 619 Bourbon St., New Orleans.

ALBERT B. PATERSON, (1923), President, New Orleans Public Service Inc., 15 Audubon Place, New Orleans.

BOYKIN W. PEGUES, (L. M.), Head of Department of Civil Engineering, Louisiana State University, Baton Rouge, La.

FRANK G. PERSCHALL, (J.), (1937), Engineering Estimator by the Sewerage and Water Board of New Orleans, Drainage Engineering Department, 526 Carondelet St., New Orleans.

PHILLIP FRANK PHILLIPS, (1933), Engineer, 4424 So. Claiborne Ave., New Orleans.

BRISTER B. PIERCE, (N. R.), (1929), Assistant Plant Engineer, Gaylord Container Corporation, Bogalusa, La.

CARROLL J. PEIRCE, JR., (1933), Civil Engineer with Sewerage and Water Board, 526 Carondelet St., New Orleans.

FREDERICK F. PILLET, (N. R.), (1922), Professor, Civil Engineering, Louisiana State University, 730 No. 10th St., University, La.

JOHN J. PORTE, (J.), (1937), Draftsman, Sewerage and Water Board, 2024 Congress St., New Orleans.

JOHN L. PORTER, (1924), Consulting Engineer, 8407 Panola St., New Orleans.

John E. Pottharst, (1937), Mechanical Equipment Corporation, 911 Carondelet St., New Orleans.

CRAWFORD POWELL, (J.), (1937), Assistant Engineer, New Orleans Purification Plant, 7725 Belfast St., New Orleans.

RAYMOND C. PROUET, (1933), Drafting Engineer, 4902 Franklin Ave., New Orleans.

PAT H. QUINLAN, Drainage Engineer, Sewerage and Water Board, 526 Carondelet St., New Orleans.

GROVER CLEVELAND RACKERBY, (1926), Permit Section, U. S. Engineers, 1st New Orleans District, 51 Neron Place, New Orleans.

WALTER S. RAINVILLE, JR., (1934), Director of Research Department, New Orleans Public Service Inc., 317 Baronne St., New Orleans.

EDWARD S. RANDOLPH, (N. R.), (1937), Designing Engineer, The Panama Canal, Box 441, Balboa Heights, Canal Zone.

CHARLES FREDERICK RANTZ, (1924), Refrigerator Engineer, 222 Homer St., Algiers, La.

JOHN REINHARD, (R. Aff.), (1931), Sales Engineer, Johns-Manville Corp., 3719 Camp St., New Orleans.

ARTHUR de R. REMANJON, (1937), Assistant Ship Surveyor, United Fruit Co., 1509 Pine St., New Orleans.

FRANK L. REYNOLDS, Vice-President, (N. R.), (1916), Irons & Reynolds, Inc., Building Construction, 420 Lexington Ave., New York City, 115 Ocean Ave., Brooklyn, N. Y.

HAMPTON REYNOLDS, (1937), Consulting Engineer, 606 Common St., New Orleans.

GERALD L. RHODES, (1934), Electrical Engineer, Power Department, New Orleans Public Service Inc., 2810 Napoleon Ave., New Orleans.

W. H. RHODES, (1927), Asphalt Sales, Shell Petroleum Corp., Canal Bank Bldg., New Orleans.

GEORGE P. RICE, (1924), Rice and Staples, Consulting Engineer, 1006 Baronne Bldg., New Orleans.

R. B. RICHARDSON, (N. R.), (1937), Engineer Construction, Louisiana Highway Commission, Baton Rouge, La.

GEORGE J. RICHAUD, (1937), Urban Transportation Work, attached to the Schedule Department and Research Department, New Orleans Public Service, 317 Baronne St., New Orleans.

HENRY R. RICHMOND, JR., (J.), (1937), 5528 Hurst St., New Orleans.

CLAIRE W. RICKER, (1928), Professor of Electrical Engineering, Tulane University, New Orleans.

A. F. RIDEOUT, (N. R.), (1937), City Engineer, De Ridder, La.

JOHN RIESS, (L. M.), (1906), Civil Engineer and Contractor, 807 New Orleans Bank Bldg., New Orleans.

PAUL L. RISTROPH, (1937), Engineer, 6407 So. Claiborne Ave., New Orleans.

C. L. RITTENBERG, (J.), Engineer with Myers Whitty & Hodge, 20 Newcomb Blvd., New Orleans.

CORWIN A. ROBERT, (1937), Surveyor, 127 No. Jefferson Davis Parkway, New Orleans.

JAMES M. ROBERT, JR., (J.), (1933), Attorney; Engineer; 317 Baronne St., New Orleans.

THOMAS H. ROBERTS, (1923), Consulting Mechanical Engineer, 1530 No. Broad St., New Orleans.

EDWIN J. H. RODRIGUEZ, (N. R.), (1918), care Johns-Manville Corp., 143 Sherwood Forest Drive, New Orleans.

PERRY R. ROEHM, (J.), (1937), Student Engineer, New Orleans Public Service Inc., 1315 Louisiana Ave.

EVERETT G. ROESSLE, (1926), Engineer, with Geo. P. Rice, 1019 Leontine St., New Orleans.

CHARLES O. ROOME, (1937), Consulting Engineer, Dubus & Co., 4004 State St. Drive, New Orleans.

LEON de SALIGNAC, (1936), Chief Engineer, Pan-American Petroleum Corp., 944 St. Charles Ave., 5124 Baronne St., New Orleans.

H. S. SALZER, (J.), (1927), Assistant Lighthouse Engineer, U. S. Lighthouse Service, 6028 Catina St., New Orleans.

WALTER HOWARD SCALES, (1930), Southern Manager, National Lumber Mfgrs. Ass'n., American Forest Products Industries, Inc., 705 Interstate Bank Bldg., 2319 Lowerline St., New Orleans.

J. G. SCHEIB, (1935), District Engineer, W. P. A., 7931 Fig St., New Orleans.

REGINALD McC. SCHMIDT, (1915), Assistant Engineer, 2nd N. O. District, 4414 So Tonti St., New Orleans.

R. C. P. SCHOENBERGER, (J.), (1937), 916 Fern St., New Orleans.

HARRY D. SCOTT, (1920), Manager, Bragman's Bluff Lumber Co., Puerto Cabezas, Nicaragua.

PAUL T. SEASHORE, (1934), Engineer, La. Land and Exploration Co., Houma, La.

GEORGE ARTHUR SEAVER, (1920), Chief Engineer, George J. Glover Co., Inc., 1219 Eleonore St., New Orleans.

P. E. SEEPE, (1936), Sales Engineer, 5935 Freret St., New Orleans.

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

REGINALD F. SEILER, (N. R.), (1935), Assistant Area Engineer, F. E. R. A., 601 Springhill St., Shreveport, La.

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

RICHARD M. SHAW, (J.), (1937), Engineering, U. S. Engineers, 2nd N. O. District, 8004 Freret St., Apart. D., 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.

HARRY H. SHUTTS, (N. R.), (1935), Civil Engineer, Lake Charles, La.

CHESTER P. SIESS, (N. R. J.), (1936), Research Graduate Assistant, 214 M. T. L., University of Illinois, Urbana, Illinois.

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

ROBERT H. SINGER, (J.), (1937), Designing and Drafting Department, Sewerage and Water Board of New Orleans, 4668 Painters St., 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., 3503 Prytania St., New Orleans.

MERCER M. SMITH, R. Aff.), (1937), Engineer, Operating Department, Electric Storage Battery Co., 428 Balter Bldg., New Orleans.

T. BAKER SMITH, (N. R.), (1919), Civil Engineer, P. O. Box 266, 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), tructural Engineer, with Geo. P. Rice Consulting Engineer, 1915 Short St., New Orleans.

DAVID STAYER, (N. R.), (1933), R. C. A. Mfg. Co., Quality Supervisor, 31 Harvard Ave., Collingswood, N. J.

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.

DAVID WHITE 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., Box 788 Wood River, Ill.

FRANK M. STONE, (1937), Architect and Engineer, 1800 Masonic Temple, New Orleans.

HERBERT C. SWAN, (1923), Assistant Engineer, 366 Pine Et., New Orleans.

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

W. W. TENNANT, (N. R.), (1937), Co-ordination Division, Standard Oil Company of Louisiana, 520 Convention St., Baton Rouge, La.

PAUL EDWARD TERROY, (R. Aff.), (1934), Chief Inspector for Hartford Steam Boiler, Inspection and Insurance Co., 7929 Zimple St., New Orleans.

ALFRED F. THEARD, (Jan. 1, 1898), (C. M. and H. M.), General Superintendent and Chief 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.

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., 1561 Exposition Blvd., New Orleans.

LOUIS M. TOGNONI, (J.), (1933), Sales Engineer, New Orleans Public Service Inc., 2814 Serantine St., New Orleans.

JAMES F. TOMKINS, (N. R.), (1932), Engineer Salesman, 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), Electrolysis Engineer, New Orleans Public Service Inc., 317 Baronne St., New Orleans.

WILLIAM N. TULLER, (J.), (1937), with U. S. Engineers, Foot of Prytania St., 508 Walnut St., New Orleans.

W. O. TURNER, (1931), Vice-President, Louisiana Power & Light Co., 142 Delaronde St., Algiers, La.

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

S. J. VAN NORMAN, (1937), Division Engineer, Sewerage and Water Board, in charge of Sewer and Water Construction and Maintenance, 4211 S. Rocheblave St., New Orleans.

W. H. VINCENT, (N. R.), (1937), Assistant Engineer, Louisiana Highway Commission, P. O. Box 335, Slidell, La.

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, 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. Engineer Office, 7433 Maple St., New Orleans.

RICHARD E. WAGNER, (J.), (1933), Civil Engineer, Resettlement Administration, 5th Region, 1818 So. Gayoso St., New Orleans.

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

WAYNE PAUL WALLACE, (N. R. J.), (1936), Instructor, College of Engineering, Louisiana State University, University, La.

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

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

HARRY W. WATERFALL, (N. R.), (1937), Associate Professor Mechanical Engineer, Louisiana State University, University, La.

PHILIP A. WEBER, (N. R. J.), (1933), U. S. Coast and Geodetic Survey, P. O. Box 10, Key West, Fla.

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), Architect (Draftsman Structural Design), 200 Stella St., Metairie Ridge, New Orleans.

WILLIAM WHIPPLE, (N. R.), (1936), Professor of Steam Engineering, Louisiana State University, University, La.

J. LESTER WHITE (N. R.), (1937), Chairman, Louisiana State Planning Commission, Baton Rouge, La.

W. S. WHITE, (L. M.), (Jan. 1, 1898), Civil Engineer, Surveying, Box 82, Sulphur, La.

CHARLES WIGGIN, JR., (1927), Sales Engineer, 400 Balter Bldg., New Orleans.

BEN WILLARD, (L. M.), (Jan. 1, 1900), Retired, 1710 Audubon St., 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), Chief Engineer, Orleans Levee Board, 3517 Jena St., New Orleans.

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 Technical Engineer, Sewerage and Water Board, 2425 Audubon St., New Orleans.

JOHN W. WILSON, (1933), Construction Superintendent, Gervais F. Favrot, Contractor, 7916 Oak St., New Orleans.

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

WALTER E. WINSHIP, (1921), 608 Common St., 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.

MARIO G. ZERVIGON, (1937), Instructor in Electrical Engineering, Tulane University, 6118 Perrier St., New Orleans.

ROBERT W. ZIFFLE, (J.), (1937), Research Department, New Orleans Public Service Inc.

STUDENT MEMBERS

G. G. AURIOLES, 570 Walnut St., New Orleans.
L. M. HAASE, 115 S. Hennessy St., New Orleans.
R. N. HABANS, 2817 Grand Rt. St. John, New Orleans.
D. E. GUIZA, 1609 So. Gayoso St., New Orleans.
W. M. PAYNE, 1025 Soniat St., New Orleans.
HUGH F. SMITH, 7223 Freret St., New Orleans.

SUMMARY

Resident Honorary Members	4
Life Members	29
Resident Members	215
Non-Resident Members	68
Associate Members	2
Non-Resident Associate Members	1
Affiliate Members	20
Non-Resident Affiliate Members	4
Junior Members	83
Non-Resident Junior Members	21
Student Members	6
Total	448

PAST PRESIDENTS

Sidney F. Lewis	1898	John Klorer	1918
Thos. L. Raymond	1899	Ole K. Olsen	1919
Henry J. Malochee	1900	John Riess	1920
Frank M. Kerr	1901	R. S. Manley	1921
Alf. F. Theard	1902	Donald Derickson	1922
Alf. Raymond	1903	J. S. Barelli	1923
J. F. Coleman	1904	James M. Robert	1924
W. B. Wright	1905	Marcel Garsaud	1925
W. H. Hoffman	1906	Farrar P. Hamilton	1926
G. W. Lawes	1907	Edward S. Lanphier	1927
C. W. Wood	1908	John L. Porter	1928
J. T. Eastwood	1909	Frederick H. Fox	1929
W. B. Gregory	1910	James M. Todd	1930
J. C. Haugh	1911	Frank G. Frost	1931
D. S. Anderson	1912	Frederick N. Billingsley	1932
A. M. Shaw	1913	John H. O'Neill	1933
W. H. Williams	1914	A. Lee Dunlap	1934
L. C. Datz	1915	Edward S. Bres	1935
Samuel M. Young	1916	Allen S. Hackett	1936
A. T. Dusenbury	1917	C. S. Williamson	1937

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Board of Direction, January 5, 1938.

The meeting was called to order by President Williamson with the following members present: Cappel, Godat, Grehan, Hackett, Newman, Hill.

The Constitution of the Woman's Auxiliary was reviewed. It was voted to recognize this group, of which Mrs. J. M. Todd is President and Mrs. W. H. Scales Corresponding Secretary.

It was voted that this group be allowed to use the letter head seal of the Louisiana Engineering Society.

There being no further business the meeting adjourned.

ARTHUR M. HILL,
Secretary-Treasurer.

Minutes of the Business Meeting of the Annual Meeting, January 7, 1938.

The meeting was called to order by President Williamson about 11 a. m. on January 7 with 350 members and guests present.

Commissioner Cave made a brief address of welcome on behalf of the city and state.

Mr. J. F. Coleman gave a short sketch on the founding of the Society, its history and ideals.

The reading of the minutes was dispensed with, the Secretary read the Financial Statement for the year 1937.

A letter from the Chairman of the Employment Committee was read.

President Williamson gave the report of the President and Board of Direction of the Society.

Mr. F. G. Frost made announcements concerning the afternoon trip and luncheon, and then gave the results of the tellers in the election.

The following were elected: President, Bernard H. Grehan; 1st Vice-President, David W. Godat; 2nd Vice-President, Boykin W. Pegues; Secretary-Treasurer, A. M. Hill; Directors, William H. Rhodes, David W. Stewart, B. Stanley Nelson. President Grehan was escorted to the platform by Mr. J. M. Todd, and retiring President Williamson presented him with his gavel. Vice-President Godat was escorted by Mr. Dusenbury, Vice-President Pegues by Dr. Lassalle, Director Rhodes by Prof. Derickson, Director Stewart by Mr. Kammer, Director Nelson by Prof. Gregory, Secretary-Treasurer A. M. Hill by Mr. Billingsley.

President Grehan made a brief speech of acceptance, and introduced the officers of the local chapters of the founder societies.

Mr. Todd announced that in 1939 the American Society of Mechanical Engineers would hold a national meeting in New Orleans. He asked that consideration be given to the combining of the annual meeting of the Louisiana Engineering Society with the A. S. M. E. meeting.

Dr. Lassalle urged that this be done, and asked that a vote be taken showing the feeling of the members present in this regard. The vote showed that a majority favored consolidation if possible.

The meeting then adjourned.

ARTHUR M. HILL,
Secretary-Treasurer.

Meeting of the Board of Direction, January 19, 1938.

The meeting was called to order at 7:45 p. m. with the following present: President Grehan, Cappel, Godat, Nelson, Pegues, Rhodes, Stewart, Hill.

President Grehan announced that he had sent letters of thanks to Committee Chairmen and Chairman of Founder Societies for their co-operation in connection with the Convention of January 7 and 8.

It was voted to reprint the Constitution, and enclose it in an every-member letter from the President.

The Standing Committees for the year 1938 were submitted by the President and approved by the Board.

President Grehan suggested the formation of a new standing committee to be called the Public Relations Committee. Such a committee would aid in the recognition of the engineer.

It was voted that the next meeting would be a continuation of the discussion of the licensing of engineers, which was started in the Saturday morning session of the Annual Meeting. It was decided to notify founder societies of the meeting. Mr. J. M. Todd will preside, being chairman of the Legislative Committee.

The President will send letters to the chairmen of the founder societies asking them to be present for the discussion. Chairmen will be asked to express their views and co-operate with Mr. Todd.

It was voted that the Student Dues be reduced from $3.00 per year to $1.00, and the Constitution be so amended through the usual proceedings.

It was resolved that warrants be signed by the Secretary-Treasurer and Chairman of the Finance Committee; on the basis of these, checks would be drawn signed by President Bernard H. Grehan and Secretary-Treasurer Arthur M. Hill.

A letter from S. E. Hottinger was read, advocating the closer alliance of various classes of engineers through club facilities. He asked that a survey be made to determine the possibilities of this. The letter was turned over to the House Committee.

A motion was made and passed that the entrance fee be suspended for the year 1938.

Prof. James M. Robert was reappointed Editor of the Proceedings, with expressions of appreciation for past services.

A letter was read from the Chairman of the Local Section of A. S. M. E. asking that we hold our convention in connection with them in February, 1939. No definite recommendation was made at the meeting, and it was decided to discuss the matter further next time.

The meeting then adjourned.

ARTHUR M. HILL,
Secretary-Treasurer.

ANNUAL REPORT

FINANCIAL REPORT OF THE SECRETARY-TREASURER

Receipts for 1937:

1935 Dues	$ 41.00
1936 Dues	173.00
1937 Dues	1,944.00
1938 Dues	25.50
Advertising	380.62
Contributions	10.00
Proceedings Sales	2.50
Bank Liquidation, Dividends, Bonds	1,130.90
Miscellaneous Income from Golf Tournament	54.89
Total	$3,762.41

Disbursements:

Proceedings Cost	$1,015.82
Entertainment	64.40
Scholarships	290.00
Printing and Postage	425.67
Present for President	30.00
Library Expense	97.29
Bond for Secretary-Treasurer	10.00
Refreshments	265.71
General Expense	331.24
Annual Meeting	289.24
Secretary-Treasurer Salary	600.00
Salary of Porter	42.00
	$3,486.37
Balance	$ 286.04
Balance left from last year brings this figure to	$1,090.00

Submitted by

ARTHUR M. HILL,
Secretary-Treasurer.

REPORT OF THE PRESIDENT OF THE LOUISIANA ENGINEERING SOCIETY FOR THE YEAR 1937

The last annual meeting of the Louisiana Engineering Society was held January 27th and 28th, 1937. The attendance at this meeting was 265, which was somewhat less than the Annual Meeting of 1936, due to the fact that the students of both Tulane University and Louisiana State University were unable to attend beause of the fact that the date of the 1937 meeting being the same as the term examinations.

This meeting was a very successful one and offered not only an interesting program but served to bring together many members of the engineering profession.

The success of this meeting was due to the careful and tireless work of the Chairman, Mr. Fred N. Billingsley and the members of the various committees selected by him and co-operating with him. The object of making the annual meeting a two-day affair two years ago, was to stimulate the interest of the engineers of the State by bringing them together not only that they may profit by contact, the one with another, but that it may be known that a live engineering group exists in the State of Louisiana, composed of men who are doing things "engineering-wise" and who are fully cognizant of the potential resources of this State, which resources will be profitably developed yet economically and conservatively so only under the direction of engineers.

Since the annual meeting, the Board of Direction has held nine meetings and there have been ten meetings of the Society, at which interesting technical papers were presented. The Technical Papers Committee, of which Mr. David Godat is Chairman, is to be complimented for promptness in providing these papers and for obtaining those of such general interest.

The average attendance at these ten meetings was 91 persons. An interesting feature of the meetings was the fact that many of our members stayed after adjournment and carried on informal discussions of the topics presented in the papers of the meetings.

An amplifying system was installed early in the year which made it possible for every one to hear clearly the papers when read and the discussion which took place during the meeting.

The May Meeting was held in Baton Rouge. It was an enjoyable and successful meeting. The Society was the guest of the Baton Rouge members and of the Agricultural and Dairy Departments of L. S. U. The latter served those present with a most delightful dinner. After adjournment of the meeting, upon the invitation of Dean Lassalle, those attending visited the exhibits of the students in connection with Engineers' Day on the Campus of L. S. U. We have always had good meetings there, and it is to be hoped that in the near future we may hold meetings not only in Baton Rouge but other towns of Louisiana. If we do it will serve to bring together the engineers of the State more closely.

Some progress was made by the Society during the year 1937. During the year the student membership decreased by nineteen, two members were dropped from the roll, but seventy-seven new members were added to the roll, so that we now have a total membership of 450. This increase in membership shows a greater interest, and is the result of different members interesting engineers in the affairs of the Society. There are yet many engineers who are not members in the vicinity of New Orleans and in the State at large. Many of these would become members if each one who is a member would exert himself to the extent of informal solicitation. Our Society is the Louisiana Engineering Society, and while domiciled in New Orleans, carries the title of Louisiana, and should obtain the membership of those engineers who are unfortunate or fortunate enough not to live immediately in the city limits of New Orleans.

During the year approximately $575.00 was received from the banks in liquidation, and some of the homesteads in which the Society has stock became insured. The increase in membership brought in more revenue and the payment of dues was more prompt than during a few previous years. The finances are in some better shape than those of the previous year, but no mention is made of this fact for aggrandizing the work of the Officers and Board of 1937, since the financial condition of the country as a whole for the previous year was reflected. It was not the fault of any officer or individual of the Society that the financial condition of

the year previous was as it was. A greater drive for membership would materially help the financial condition of the Society, and would enable the organization to function on a better plane.

In June a successful golf tournament and smoker was held at the Colonial Country Club. The committee in charge of the entertainment is to be congratulated, in fact praised, for the fine time they made every one have, even to guaranteeing and having good weather. Many and excellent prizes were given in this tournament and the entertainment provided at the Smoker was suitable for the occasion.

This Smoker was put on for the small cost of $13.00. We recognize the good work which Mr. Carroll Peirce and the other members of the Entertainment Committee did in providing this successful outing.

The Employment Committee, of which Mr. R. H. Baumbach is Chairman, has done efficient and constant work during the year. Reports from this committee have been had at each regular meeting.

This report would not be complete without mentioning the Woman's Auxiliary to the Louisiana Engineering Society. This organization, while it has given every co-operation to the Society as such, is now formally a part of our organization as it has been officially designated at the request of its members by the Board of Direction as the "Woman's Auxiliary to the Louisiana Engineering Society." Nor can I consider it complete without paying a tribute to Mrs. W. B. Gregory, who so wisely saw what a help the members of the engineers' families could be, if banded together in an organization of the type she organized, and named the "Woman's Auxiliary to the Louisiana Engineering Society." They are doing what they can for the success of our profession and may we always be as co-operative with this woman's organization as they have been with ours.

I wish to express to the members of the Society my appreciation of the honor I have had in serving you as President, and to thank the Board of Direction for their guidance, the members for their splendid interest and co-operation, and the Chairmen and members of the various committees for their co-operative work throughout the year.

As I retire from the highest office our Society can confer, I bespeak for the Louisiana Engineering Society fullest development of membership, the greater cementing together of the engineering profession of Louisiana, and fullest reaping of the rewards collectively and individually which are due the engineers for their constructive and conservative work not only where public welware is involved but where private enterprise employs.

C. S. WILLIAMSON.

ACTIVITIES OF LOCAL SECTIONS

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STUDENT CHAPTERS

Louisiana State Univ.
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Tulane University
New Orleans

Special Meetings at
call of President

A Luncheon Meeting of the Section was held at Galatoire's Restaurant, in New Orleans, on April 9th, in honor of Dr. Henry Earle Riggs, President of the American Society of Civil Engineers.

About 35 members of the section were present to hear Dr. Riggs talk on "Activities of the Society," in which he emphasized the fact that the Society was not a New York Society but a National organization with New York representation on the Board of Direction in the minority.

Dr. Riggs had represented the American Society of Civil Engineers at the dedicatory exercises at Louisiana State University, and while there was the honor guest at a dinner given by the L. S. U. Student Chapter. In addition to Dr. Riggs the Chapter had as its guests: Dr. S. L. Sackett, Dean Emeritus of Penn. State; Professor S. Timoshenko, of Stanford University; and Mr. N. E. Lant, Bridge Engineer of the State Highway Commission, who represented the Louisiana Section at the exercises.

On April 9th a visit was made to view the construction of the Mississippi River Bridge at Baton Rouge by 25 members of the Tulane University Student Chapter. They were given a luncheon and shown over the work by Mr. N. E. Lant, State Bridge Engineer, and his Assistant, Mr. Erickson, and by Dr. C. C. Melville.

Representatives of the Tulane and L. S. U. Student Chapters will attend the Section meeting of the American Society of Civil Engineers in Jacksonville, on April 20th. Mr. A. J. Negrotto will represent the Louisiana Section at this meeting.

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

FEBRUARY, 1938

"PATRONIZE OUR ADVERTISERS"

INDEX TO ADVERTISEMENTS

This Journal reaches the officials with whom rests the responsibility for the bulk of the municipal, state and industrial works in Louisiana and the surrounding territory. Its advertising pages afford you an effective and dignified means of cultivating a wider acquaintance among prospective buyers.

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PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XXIV. APRIL, 1938 NO. 2

CONTENTS

EDITORIAL NOTES AND COMMENT

Licensing Law for Professional Engineers. Our Legislation Committee under the guidance of Chairman Todd is doing yoeman service in composing a law to amend and re-enact No. 242 of 1920. They are using as their basis the Model Law for the Registration of Professional Engineers and Land Surveyors. Slight modifications of this law are being made to meet local conditions.

Forty States already have licensing laws. Arguments can be advanced for and against such measures. However, since so many states now have it, the problem of intra-state engi-

neering work will be simplified. Alabama and Texas have acts based upon the model law.

It is the intent of the committee to have the proposed law introduced into the coming session of the State Legislature, providing it meets with the approval of members of the Louisiana Engineering Society and local sections of the Founder Societies.

The law cannot please everyone, but it does represent a conscientious effort of many engineers of national importance, and has been modified to suit our particular needs. The intent is to raise the standards of the profession. Let's all pull together for it.

Our Advertisers. In this issue we carry new advertisements and rearrangement of advertising material. How do you like the new set-up? The new material is a result of our Publications Committee, Division B, headed by Mr. Dave Stewart. The advertisers have helped us; let us in turn help them.

New Members. The following new members have been elected as a result of a letter ballot on March 4:

Alfred E. Abaunza, Member, age 27. Endorsed by B. H. Grehan, Donald Derickson, J. C. Baehr. Career: Graduated from Tulane University in Civil Engineering, 1935. 10 years civil engineering experience with U. S. Engineers. 5 months contracting engineering. Address: 4032 St. Charles Avenue.

A. W. Brodtman, Non-Resident Member, age 26. Endorsed by Profs. Donald Derickson, William Gregory and J. M. Robert. Career: B. E. in C. E. Tulane, 1933. December, 1933-August, 1935, Laboratory Assistant U. S. Waterways Experiment Station at Vicksburg. August, 1935-April, 1936, Inspector Levee Construction, U. S. Engineers. April-July, 1936, Inspector Concrete Construction Fort Peck Dam. July, 1936, to date, Resident Engineer Sternberg Dredging Co. of St. Louis, levee and channel construction. Address: P. O. Box 574, Franklin, La.

F. James Germano, Non-Resident Member, age 27. Endorsed by Dean L. J. Lassalle, Prof. F. F. Pillet, W. P. Wallace. Career: One year as assistant superintendent John Arborio Construction Co., Poughkeepsie, N. Y. Two years assistant to Designing Engineer, Metropolitan District Comm., Hartford, Conn. Two years instructor in Civil Engineering, L. S. U. Degrees of C. E., M. CE., D. C. E. from Rensselaer Polytech. Address: 845 Main Street, Baton Rouge, La.

Walter Godchaux, Jr., Non-Resident Junior, age 23. Endorsed by Jules Godchaux, Harold Levey, A. M. Hill. Career: Grad. M. I. T. in 1935 with degree of B. S. in Chemical Engineering. Since graduation, one year as engineer in charge of construction and superintendent in charge of operating by-product plant of Godchaux Sugars, Inc. 1937 to date Assistant Engineer at this refinery. Address: Reserve, La.

James P. McCullough, Non-Resident Member, age 29. Endorsed by W. S. Henning, Harry B. Henderlite, N. E. Lant. Career: Two years of Chemical Engineering at L. S. U., 1926-1929. Student Draftsman, La. Hwy. Comm., 1927-28, and rodman, part of '28. Draftsman, La. Hwy. Comm., 1929 (Sept.). One month in 1929 with Miss. River Comm. Assistant to Right of Way Engineer of La. Hwy. Comm. from Oct. 15, 1929-Oct. 13, 1930. Right of Way Engineer for Comm. Oct. 13, 1929, to date. Address: 1828 Oleander Street, Baton Rouge, La.

Ernest L. Mire, Member, age 29. Endorsed by V. J. Bedell, J. A. McNiven, W. T. Hogg. Career: October, 1924-March, 1926, Rodman Board of Commissioners. March, 1926-July, 1926, with Gwin Construction of Tulane Stadium. July, 1926-December, 1926, Instrumentman for Board of Commissioners. December, 1927 to November, 1934, Draftsman and Instrumentman engaged in general railroad engineering work, including valuation work. Chief of party on preliminary surveys in connection with extensions to bridge. November, 1934-February, 1937, in charge of maintenance of tracks and structures together with the construction of about 10 miles of double main track from parish line to Avondale. In February, 1937, appointed Assistant Engineer in direct charge of Engineering

Department, maintenance of tracks and structures, including Mississippi River bridge, reporting to Mr. V. J. Bedell, General Manager and Chief Engineer. Address: 5420 Fontainebleau Drive, New Orleans, La.

A. R. Rodriguez, Member, age 34. Endorsed by A. J. Harris, J. M. Todd, Chas. Wiggin. Career: 14 years with Standard Fruit and Steamship Co., last position with them as designing engineer. Later designer with Penn. Shipyards, Beaumont, for one year. Then engineer and designer in private work on tugs, barges, etc. Buildings, hydraulic pumping plants, dredges and consultation. Presently designer and consultant also representing the St. Louis Shipbuilding and Steel Company, St. Louis, and naval architect for them. Address: 4418 St. Ann Street, New Orleans.

Norman H. Ross, Affiliate Member, age 44. Endorsed by B. H. Crehan, Ole K. Olsen, C. Glenn Cappel. Career: 1915 with A. B. Wood, Chief Engineer of Sewerage and Water Board, as draftsman for Calumet Water Works job, Chicago. 1916 completed special course Loyola University in Naval Architecture. 1917 with Jahncke Dry Dock and Shipbuilding Company as Naval Architect. 1918 with Gilbert D. Von Phul as draftsman on sugar machinery. December, 1918, to date, with Ole K. Olsen as estimator and salesman, reinforcing steel, building specialties and contractors' equipment. Now secretary of Ole K. Olsen, Inc. Address: 4516 S. Johnson Street.

Alfred J. Roth, Jr., Member, age 28. Endorsed by Harry Jacobs, S. E. Huey, I. C. Daniel. Career: Graduate of L. S. U. in Civil Engineering, 1934. Employed since graduation by State Board of Engineers as field man making surveys for levees and drainage. Address: 1502 Gov. Nicholls Street, New Orleans.

Arthur M. Scott, Member, age 50. Endorsed by B. H. Grehan, Ole K. Olsen, Alvin Fromherz. Career: 1910 to date, structural Engineer with Ole K. Olsen. Address: 7035 Chestnut Street, New Orleans.

Henry L. Thackwell, Non-Resident Member, age 49. Endorsed by W. B. Gregory, H. L. McLean, J. B. Converse. Career: Member A. S. C. E. Registered Civil Engineer in Louisiana,

Wyoming and Colorado. (Attached to Mr. Thackwell's letter is a printed résumé of his activities as printed by A. S. C. E. in transferring him from Associate to Full Membership. His field of activities seems varied, but deals primarily with construction work. This list of activities would cover about three typewritten pages.) Address: 209 E. Cotton Street, Longview, Tex.

Golf Tournament and Smoker. Word comes to us that the Annual Golf Tournament and Smoker will take place this year on June 15 at the Colonial Country Club.

Last year it was a very successful affair. Individuals and companies contributed generously. The Entertainment and Outing Committee did a splendid job in arranging events and obtaining truly handsome prizes.

Plan to attend this year. Chairman Peirce promises good food and a good time for all. Remember: Wednesday, June 15.

Society Scholarships for Engineering Students. We wish to call attention to the fact that each year the Louisiana Engineering Society awards one scholarship at Tulane University and one scholarship at Louisiana State University to deserving students in engineering. The rules for making awards were amended some time ago and we print below the amended rules:

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 unail the undergraduate course of study has been completed, provided proper scholastic grades have been maintained in accordance 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.

The Chairman of the Awards Committee is Prof. Boykin W. Pegues. Head of the School of Civil Engineering, Louisiana State University.

Determination of Cotton Fiber Properties. In this issue we publish a very interesting research paper entitled "The Determination of Cotton Fiber Properties as an Engineering Problem." This paper, by Mr. M. G. Zervigon, one of our younger members, is most interesting in detailing the methods of determining length and quality of cotton fibers in a sample

selected at random. It is no mean task to develop an instrument which will give reliable results quickly when placed in the hands of an unskilled operator.

Error in Membership List. Through some error the name of Mr. Arthur A. Grant, Canal Bank Building, New Orleans, was omitted from the 1938 list, published in the February issue.

Library. The library has recently received a copy of "Wood Structural Design Data." The National Lumber Manufacturers' Association supplied this and five supplementary bulletins through Mr. Walter H. Scales.

Death of Mr. Paul E. Terroy. On April 10, 1938, one of our valued members, Mr. Paul E. Terroy, passed away. Mr. Terroy was a Canadian by birth, and was connected with the Hartford Steam Boiler Inspection and Insurance Company since 1917. He joined the Society as an Affiliate Member in 1934.

PAPERS AND DISCUSSIONS

THE DETERMINATION OF COTTON FIBER PROPERTIES AS AN ENGINEERING PROBLEM

By M. G. Zervigon *

Presented before the Society October 11, 1937.

INTRODUCTION

In competing with other textile fibers the cotton textile industry is handicapped by lack of specific information on the correlation of fiber properties with the properties of the finished cotton products. As might be expected, this is accompanied by the lack of a comprehensive theory with a scientific basis which might explain the behavior of the fibers in the steps of processing and in the finished yarn. Both of these deficiencies are rendered difficult of elimination by the lack of fundamental knowledge regarding the physical properties of the cotton fibers themselves and by the scarcity of practical, accurate methods for measuring these properties.

It is understandable that insufficient engineering and scientific thought has been devoted to this problem when it is considered that the cotton textile industry is steeped in tradition, and that it has grown, for the major part, in relatively small, scattered units, which make organized research difficult.

As an illustration of the more general problem, this discussion will take up in some detail the story of a particular study now going on at the University of Tennessee. This may give an idea of the fundamental nature of the problem.

For some years the botanists of the University of Tennessee Agricultural Experiment Station have been interested in cotton breeding studies, as are indeed many other investigators throughout the South. Their program at one time called for the comparison of the quality of cottons represented by several thousand relatively small samples. Surprisingly enough, they confronted a major problem when they asked themselves the simple question "Which of these cottons is better and which is worse?" because in order to answer that question they had to answer first

* Member, Instructor in Electrical Engineering, Tulane University.

the more fundamental question "What makes one cotton better than another cotton?" Spinning tests were eliminated because of practical difficulties; it remained for them to decide what properties of the cotton would be taken as criteria of quality. Following the practice of the cotton industry they adopted length of fibers as one of the properties desirable to measure. The next decision had to do with the method to be used for measuring length. Looking again at industrial practice, the botanists considered the method used by the industry. And here the cotton industry furnishes one of its surprises to the layman. Length of fibers is not measured by a technician with measuring instruments; it is estimated by an artist using nothing but his skilled fingers, his eyes, and the north light. The cotton classer quickly estimates the "staple length" of a given sample of cotton to within one thirty-second of an inch, and achieves remarkable consistency in doing it.

The cotton industry has learned to use the classer's staple length as one criterion of quality and as a preliminary guide in some processes. For more discriminating studies staple length is inadequate. It is not definitely correlated to important length statistics of the fibers; indeed it may be best defined as "the length the cotton classer finds when he classes cotton."

For a complete study of length of fibers as related to quality, it is probable that a single length statistic is insufficient and that the length distribution of the total fiber population of a sample should be known. Many invesigators have recognized this, and do analyze samples into more or less detailed length distributions. In most cases this is done by means of an instrument called a cotton sorter. By the aid of this instrument the fibers of the chosen sample are gradually separated into length groups which are subsequently weighed on a micro-balance, and a distribution curve is plotted with weight and length as coordinates.

In order to achieve reasonable accuracy with this method, skilled operators and considerable time are required. These features made the use of the sorter prohibitive in the particular case at Tennessee. And this left the botanists still without

means of measuring accurately and conveniently that fundamental, simple property of the fibers, their length.

At this point Mr. Newman Hancock, of the Agricultural Experiment Station, mentioned the problem to Dr. K. L. Hertel, Head of the Department of Physics. Dr. Hertel suggested an optical method for fiber-length analysis, and proceeded to direct its development with the backing of the Station. This development is still in progress. One of the instruments designed to make use of the optical principle is shown schematically in Figure 1. A sample of cotton C, in this case a cot-

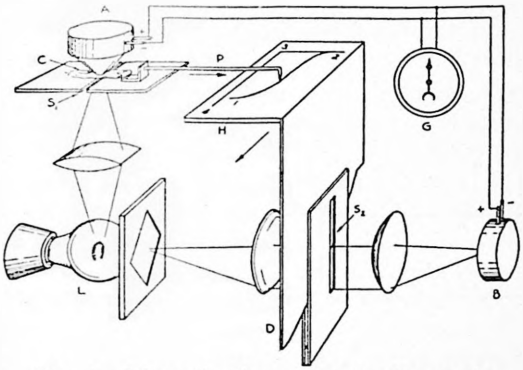

FIG. 1. Schematic diagram of the fibrograph.

ton seed with a portion of the fibers straightened, is moved in front of a photo-cell A. A cam D is moved in front of an identical cell B. The light reaching A is determined by the thickness of the cotton sample at each position, and the light reaching B is determined by the position of the cam D. The galvanometer G indicates the null point. By properly shaping cam D and maintaining the galvanometer at zero by means of D as the cotton passes A, the pen P may be made to trace on card H a curve with light absorbed by the cotton as one coordinate and corresponding length of sample for the other coordinate. If it may be assumed that the light absorbed by the sample is a function only of the number of fibers in the sample, the cam D may be calibrated so that the curve will read directly relative number of fibers versus length of fibers, which gives a length distribution curve of the type sought.

This instrument or "fibrograph" permitted an unskilled operator with a little practice to trace a curve in two or three minutes. The preparation of the sample required about twice that length of time.

In calibrating the measuring element D, a study was made to determine whether the assumption mentioned above was justified; that is, the variations in light absorbed at various positions of the sample must be demonstrated a function only of the variation in the number of fibers from one position to the other. Experiments demonstrated that properties such as fiber fineness, color, and opacity did not affect the results if these properties did not vary in the same sample. This is not strange, since the instrument is calibrated for relative, rather than absolute, number of fibers. It was found also that the average sample did not vary in color, opacity, etc., enough to vitiate the results, but the average fineness of the fibers was found to vary appreciably from one end of the sample to the other. This introduced an error, for it was found that the light absorbed was proportional to the square root of the linear density of the fibers, which implies a direct proportionality with the average equivalent diameter of the fibers. The data obtained showed that this error was very considerable in the curve of "fibrogram" for single-seed samples, but it was reduced greatly or practically eliminated by combining a number of single-seed fibrograms. This immediately suggested a modification of the method to accommodate a sample made up of a number of seeds. This is possible in the present design of fibrograph. For various practical reasons, however, the seed sample leaves much to be desired, and limits unduly the range of application of the instrument. The seed sample was chosen in the first place because the alignment of the fiber ends at the seed surface produces a familiar type of curve in the fibrograph, namely a curve of length of fibers versus cumulative number of fibers. This graph is very pictorial and easy to interpret.

An attempt to use a more general, more easily obtainable, and a more practical type of sample, led to the study of the random sample that results from clamping a sliver or roving of cotton fibers along a line and combing out the fibers not held

by the clamp. The interesting results of this study may be summarized by reference to Figure 2. Assuming that the length distribution of a cotton approaches the probability

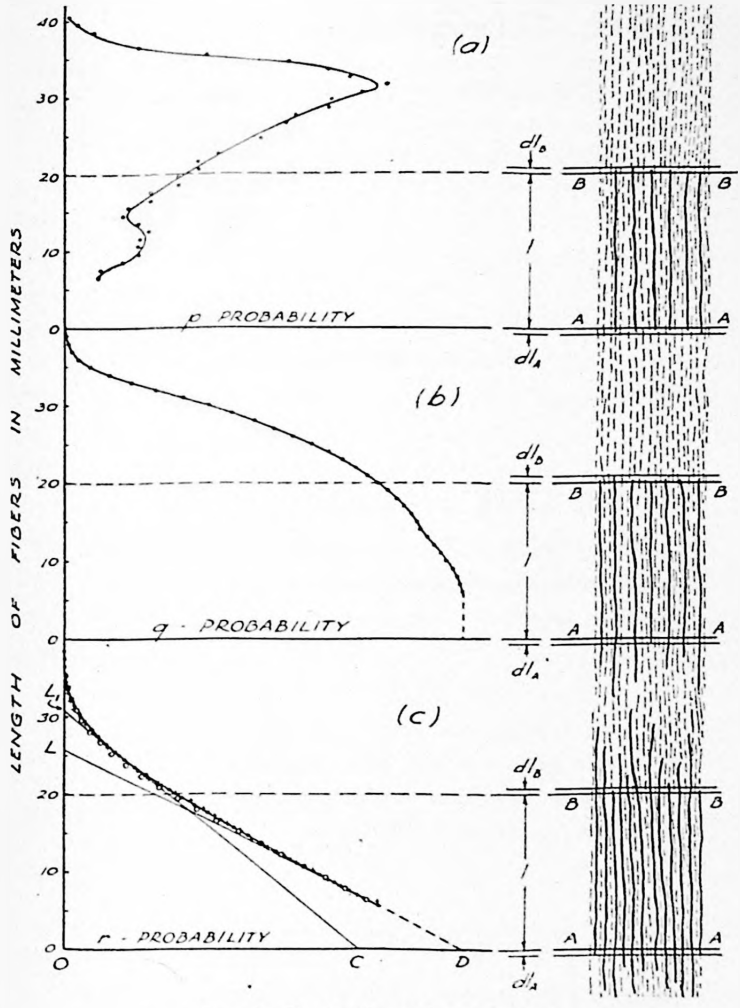

FIG. 2. Derivation of fibrograms.

curve (a), an integration under this curve along the length axis produces a curve of the type (b). The latter curve is of the type obtained in the fibrograph from a seed sample or any aligned sample. A second integration under curve (b) along

the length axis produces a curve of the type (c). It may be shown by relatively simple mathematics of probability that this last type of curve is obtained in the fibrograph from the analysis of the clamped random sample mentioned above. Indeed, the curves of Figure 2 were plotted from detailed experimental data checked at (c) by fibrograms. The crosses and circles at (c) refer to the fibrograms.

The interpretation of the random fibrogram greatly enlarges the usefulness of the instrument, for it permits the analysis of large, mixed samples of cotton in various stages of processing. A simple sampling device enables the operator to obtain a clamped random sample from any cotton stock. A further advantage results from the nature of the curve as a picture of the arrangement of the fibers as they will appear in roving and yarns. This suggests the application of the fibrograph to such practical uses as drafting roller settings in the spinning mill. It may also serve to study the behavior of the fibers in the yarn, and indeed some apparently significant progress has been made in this direction.

The fibrogram of the random sample permits the easy evaluation of important length statistics. For example, a tangent to the curve such as CL_1 (Figure 2), has an intercept OL_1 equal to the mean length of all fibers longer than the length ordinate at the point of tangency, and the ratio $\frac{OC}{OD}$ gives the proportion of the total weight of the sample due to the same group of fibers. The tangent DL has an intercept OL equal to the mean length of all the fibers.

The present design of the fibrograph uses the clamped random sample and the results are very gratifying. The investigation continues at Tennessee, and it gives promise in some allied studies as well.

The foregoing description has been covered to illustrate a particular approach to one phase of the problem. It is hoped that other approaches will be made and other phases will be studied by others. Co-operative engineering and scientific

thought is needed. The benefits that might result to the cotton grower and spinner and to the South in general from a concerted effort in this direction are incalculable.

REFERENCES:

"An Optical Method for the Length Analysis of Cotton Fibers," by K. L. Hertel and M. G. Zervigon, Textile Research, Vol. VI, No. 7, pp. 331-339. (1936).

"Application of the Seed Cotton Fibrograph to Lint Cotton," by K. L. Hertel, Journal of the Tennessee Academy of Science, Vol. IX, No. 2, April, 1936.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Board Meeting on February 14, 1938.

The meeting was called to order at 7:30 p. m. in Room 422, St. Charles Hotel, by President Grehan. The following were present: Godat, Nelson, Pegues, Rhodes, Stewart, Williamson, Hill.

The minutes of the last meeting were read and approved.

The budget was submitted by Finance Chairman Godat, and approved. It was voted that the cost of Proceedings include $25.00 for Miss Powell, Assistant to the Editor. (This is $25.00 for one year.)

It was asked that the Publications Committee make a study of the "Proceedings" to determine whether it would be advisable to alter them in any way.

The Board also asked that the Library Committee determine what measures they thought necessary to bring it up-to-date.

There being no further business, the meeting adjourned.

ARTHUR M. HILL, *Secretary.*

Minutes of the Regular Meeting of the Society, February 14, 1938.

President Grehan called the meeting to order with about seventy-five members and guests present.

The reading of the minutes were dispensed with. The report of the Chairman of the Employment Committee was ready.

The meeting was then turned over to Mr. Todd, Chairman of the Legislation Committee. He outlined the work which had been done on previous occasions in connection with the Licensing Law for Professional Engineers.

The law which had last been placed before the Legislature was read section by section, and discussed.

Many expressions of opinion were brought to the floor, and it was finally moved that the Legislation Committee draft a law and submit it to the membership of the Louisiana Engineering Society and local sections for approval. It was planned to introduce the law into the coming session of the Legislature.

The meeting adjourned to the usual collation.

ARTHUR M. HILL, *Secretary.*

Minutes of the Meeting of the Board, March 11, 1938.

President Grehan called the meeting to order with the following present: Cappel, Nelson, Stewart, Rhodes, Williamson, Hill.

Minutes of the last meeting were read and approved.

It was asked that the Secretary discuss items in connection with the Proceedings with the Editor.

It was voted to list the telephone number of the Society in the directory as the same number as the Secretary-Treasurer's residence phone.

An invitation from the Board of Supervisors of Louisiana State University was read. It was voted that some one should represent the Society at the symposium to be held on April 6, 7 and 8 at the University.

Mr. Cappel reported on activities of the Membership Committee. Mr. Stewart suggested that some engineers connected with the Port of New Orleans would be interested in membership.

Mr. Nelson reported on the actions of the Technical Papers Committee. It was decided that the matter of holding joint meetings with founder society local sections be left to the discretion of the committee.

After reading a letter from Mr. Todd in connection with the A. S. M. E. 1939 Annual Meeting to be held in New Orleans, it was voted to hold our own Annual Convention in January as provided for in the Constitution. It was voted that the Louisiana Engineering Society cooperate in every way possible, and that a special meeting be called to support the session of A. S. M. E.

It was voted that the books be audited.

A letter from Mr. Todd concerning awards was read. It was thought best, due to financial considerations, to defer such a custom until the membership embraces a larger number.

It was voted that the Baton Rouge meeting be held on Friday, May 6, and that a golf tournament and smoker be held in May or June.

Adjourned.

ARTHUR M. HILL, *Secretary.*

Minutes of the Regular Meeting of the Society, March 14, 1938.

President Grehan called the meeting to order in the Convention Hall of the St. Charles Hotel with 110 members and guests present.

The reading of the minutes was dispensed with.

The report of the Chairman of the Employment Committee was presented.

Mrs. Hu B. Myers made an announcement concerning the Night Club Party to be held on March 17, and urged all to attend.

Mr. Nelson, Chairman of the Technical Papers Committee asked that the April meeting be changed from the usual second Monday to the first Monday, April 4. This was agreed.

Dr. John C. Karcher, President of Geophysical Service, Inc., spoke on "Geophysical Prospecting." The lecture was illustrated and very interesting, as the topic dealt with exploration for oil and salt in our own state.

The meeting was concluded with discussion from the floor and questions.

The members and guests then adjourned to the usual collation.

ARTHUR M. HILL, *Secretary.*

ACTIVITIES OF LOCAL SECTIONS

President,
W. H. RHODES

1st Vice-President,
A. J. NEGROTTO

2nd Vice-President,
N. E. LANT

Secretary-Treasurer,
J. A. McNIVEN

STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

Special Meetings at
call of President

On Monday, June 13, there will be a joint meeting of Louisiana Engineering Society and the American Society of Civil Engineers. Mr. Hampton Reynolds, Chairman of the New Orleans Development and Planning Commission, will speak on "Past and Proposed Public Work Improvements in New Orleans." The meeting will be held at 8 p. m. in the St. Charles Hotel.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

APRIL 1938

"PATRONIZE OUR ADVERTISERS"

INDEX TO ADVERTISEMENTS

The Proceedings of the Louisiana Engineering Society

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New Orleans, La.

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LOUISIANA ENGINEERING SOCIETY

Suite 422 St. Charles Hotel

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LOUISIANA ENGINEERING SOCIETY

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C. W. Ricker
R. A. Steinmeyer
W. P. Wallace
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PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XXIV. JUNE, 1938 NO. 3

CONTENTS

EDITORIAL NOTES AND COMMENT

Retirement of Professor Gregory. Professor William B. Gregory will retire from active service at Tulane University at the close of the present academic session (August 31, 1938).

He completes, officially (but not actually, we feel sure), an active and useful life of devoted service to the institution with which he identified himself as a young man.

Forty-four years is a long time to be both active and useful, and he has been just that each year of the forty-four. We have all looked at him with considerable admiration and much envy —admiration for his intellectual stature and professional attainments; envy for his ability to work long and hard.

To hundreds of young men who have sat in his classes he has been an inspiration and a leader in their intellectual development.

His activities in the Society have been many and varied. Joining the Society in 1907, he has worked continually in its

upbuilding. As its President in 1910 he inaugurated "the usual collation" after meetings—an institution which has done more to promote a spirit of informal friendliness among the members than any other activity.

We shall still count on his activity and advice in the affairs of the Society.

We rejoice with Professor Gregory in the fact that he retires in the full vigor that has characterized all his active life. He has never had much time for play. "Rest is for the weary, but leisure is for the active." It is leisure to which he retires, not rest.

The Modern Prospector. The present day methods of prospecting for salt domes and other deposits in this section is described in an article in this issue.

What's under the ground has always been a subject of keen interest, and many devices from the hazel twig which "dipped" at the "proper time" to proven scientific methods have been used.

The article is of particular interest to residents of this section. While the abstract is rather brief, Mr. Karcher, in his extemporaneous talk before the Society, went into great detail, and gave the members an intensely interesting discussion of the methods used.

The Baton Rouge Meeting. On Friday, May 6, a number of members and guests of the Society drove to Baton Rouge for the May meeting.

Under the able guidance of Chairman Wallace, the evening started off with a delicious buffet supper in the basement of Highland Hall.

Dean Lassalle acted as toastmaster and introduced a number of guests present. He then turned the meeting over to Professor McMillen, who spoke on "Library Service in Connection with Engineering." The talk was interesting and his stories were some of the best we have heard in a long time.

The group then went over to see the various mysterious devices which were set up for Engineers' Day. The boys produced some clever and amusing stunts with various mechanisms, most of which were electrical.

We believe all who attended were well repaid for the drive. Those who go each year look forward to the trip. Those that don't go just miss a darn good time.

John F. Geis. On May 30 the Society suffered a loss in the death of one of our most genial members, John F. Geis. Mr. Geis was connected with the Johns Manville Company, and had been an affiliate member since 1929.

PAPERS AND DISCUSSIONS

GEOPHYSICAL PROSPECTING IN PETROLEUM EXPLORATION

By J. C. KARCHER *

The word "geophysics" is of Greek origin and means physics of the earth.

In the field of applied geophysics efforts have been directed toward discovery of mineral resources hidden beneath the earth's surface. Four different methods of geophysical exploration have been used in petroleum exploration with reasonable success. These are the magnetic, the electric, the gravimetric and the seismic methods.

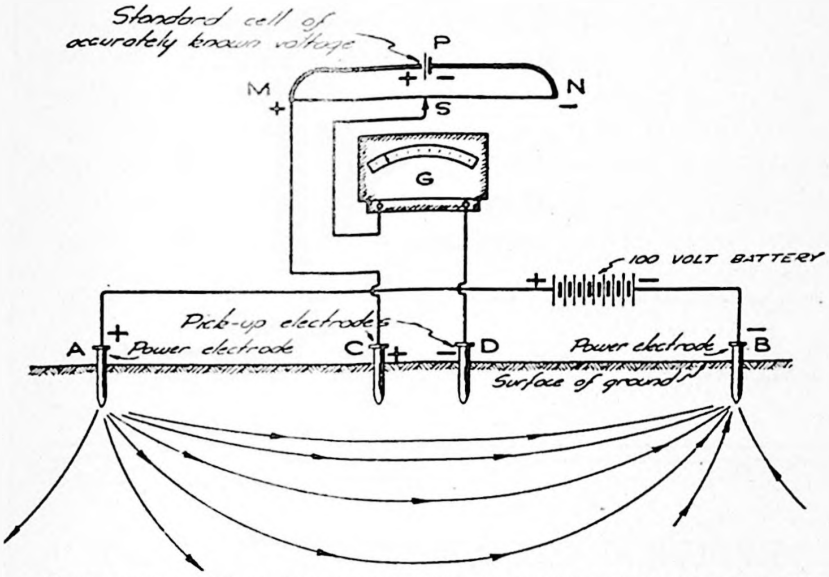
In the magnetic method the variation of the density of the earth's magnetic field is measured from place to place on the earth's surface by means of a magnetometer. The magnetometer in principle is a highly sensitized dip needle. When used to measure the vertical components of the earth's magnetic field, the needle is maintained in a substantially horizontal position, and the deviation from this position is noted. When used to measure the horizontal intensity of the earth's magnetic field, the needle is placed in a vertical position and the deviations from this position noted. The values of the earth's intensity at the several points of observation are plotted on a map and lines of equal magnetic intensity are drawn on the map. The value of such information is based on the assumption that there is a relation between these isomagnetic lines, (commonly called isogams) and structural contours.

The second method is the electric method, wherein two or more electrodes are placed in the ground and through which an electric current, either direct or alternating, is passed. The variations in the current field are determined either by means of two exploring electrodes between which potential measurements are made, or by means of a conducting loop, by which latter means the variations in the magnetic field which result from such ground currents are observed.

* President, Geophysical Service, Inc., Dallas, Texas. Presented at the meeting of March 14, 1938.

Various methods of presenting the data thus obtained are used. Figure 1 illustrates a simple arrangement showing the Wenner method of using four electrodes, of which two are current electrodes and two are potential electrodes.

The third method is the gravimetric method. It has been observed that in many instances the gravitational field over a



—SCHEMATIC DIAGRAM SHOWING METHOD OF MEASURING SURFACE POTENTIALS.

FIGURE 1.

structure is different from the gravitational field surrounding the structure; or, as in the case of mining, the gravitational field over ore bodies is different from that of the surrounding country. These gravitational effects are observed either by the use of a torsion balance which measures the gravity gradient at any point, or by means of a gravity meter which measures the variation in gravity directly from place to place.

For many years the torsian balance was the only instrument which could be used successfully to observe gravity changes. However, during the past few years the gravity meter seems to be superseding the torsion balance because the data obtained appears to be more significant, and further because such data can be obtained with greater ease.

Many salt domes in the Gulf Coast area have been discovered by means of the gravimetric method.

The fourth method, as aforementioned, is the seismic method, which at the present time seems to have the most extensive use. Structure is directly determined by this method, since by its use geophysicists are able to determine the actual position of the rock strata in the subsurface.

The seismic method consists of two distinct types of procedure, one known as the refraction method and the other as the reflection method.

The refraction method consists of placing the charge of explosive in a shallow hole in the ground and placing a seismic detector at some distance away, which distance is usually more than three times the depth of the rock stratum to be identified. Figure 2 illustrates the path taken by a point on a seismic wave front when the wave undergoes refraction as it enters the earth and encounters a high-speed stratum below a stratum of lower speed. It is interesting to note that because of this refraction a wave can travel downward in the earth to a high-

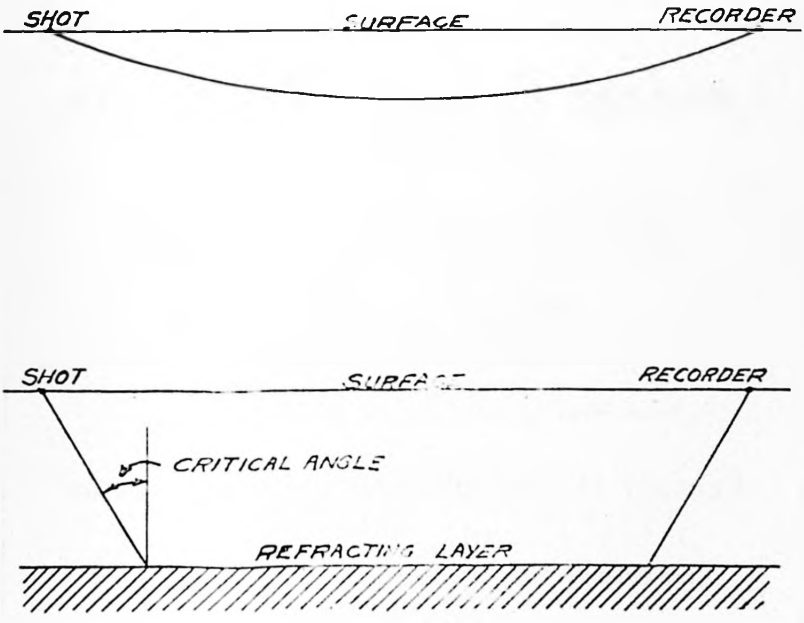


FIGURE 2.

speed stratum, travel substantially horizontally and emerge either to the first formation, or to the first formation and finally to the surface. By determining the velocities of the materials through which the wave travels it is possible to calculate the depth to the high-speed stratum; and by repeating this procedure with several points it is possible to make a structural map of the area. Many salt domes in the Gulf Coast area have been discovered by this method. Because of the fact that a salt cap usually has considerably higher velocity for seismic waves than the surrounding medium, when a charge is exploded on one side of a salt dome and observed on the other, the time of arrival is considerably decreased over that required for a wave to travel the same distance when a salt dome is not present between the source of the seismic wave and the detector. This fact becomes a means for recognizing the presence of a dome in the vicinity. Figure 3 illustrates the manner in which a point on a seismic wave front travels from the surface through a salt dome and back to the surface.

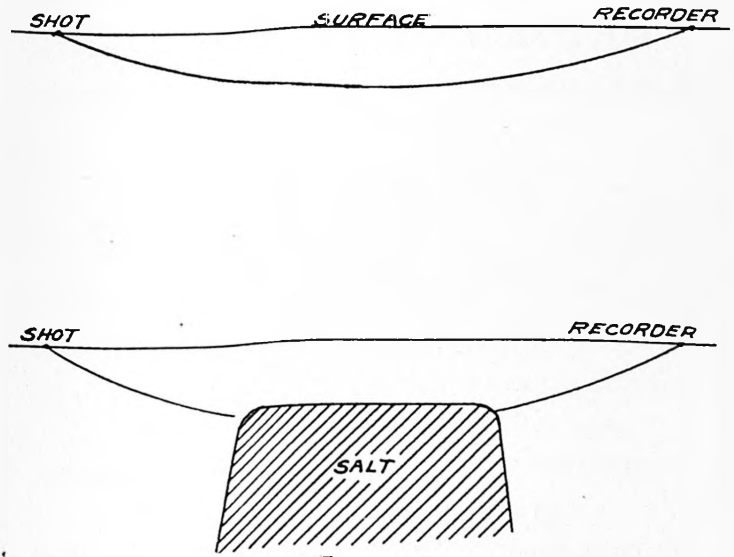


FIGURE 3.

Most of the salt dome structures in Southern Louisiana have been discovered by the refraction method; and what was perhaps the largest single endeavor in seismic prospecting was the refraction survey made of some two million acres of lease interests owned by the Louisiana Land and Exploration Company, during the progress of which about nine domes were discovered.

The reflection method consists of recording, by means of one or more detectors usually placed in sequence on the surface of the ground, waves produced by setting off an explosive charge nearby, which waves travel downward and are reflected from the various rock strata and returned to the surface.

Figure 4 diagrammatically illustrates the manner in which a reflected ray travels from the source to the reflecting layer

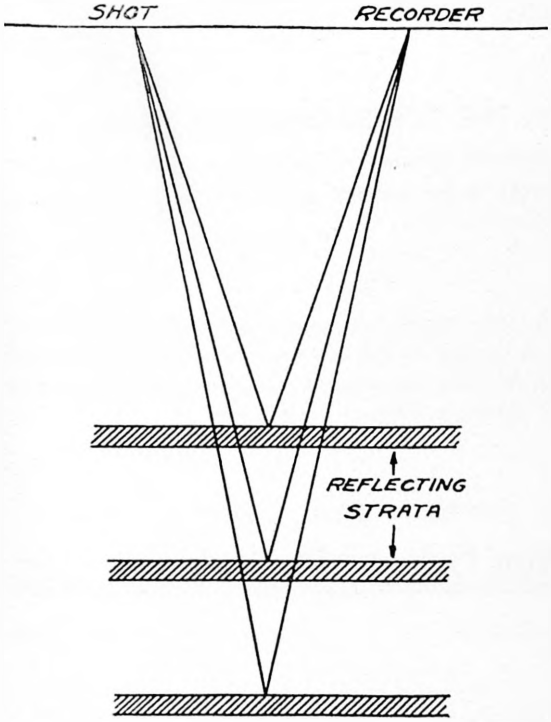


FIGURE 4.

and thence to the surface. It is easily seen that in a general way the path which the reflected ray travels describes an isosceles triangle, the base of which is the distance between the source and the detector. By knowing the velocity of the seismic wave and the length of the base of the ososceles triangle, it is easy to compute the length of the median line, which is the depth to the reflecting horizon.

At the present time the method of geophysical prospecting most used in petroleum exploration is the seismic reflection method. This is probably due to the fact that the method is the most direct one of the proven practical methods.

It appears that more than half the major structures (structures capable of producing more than twenty million barrels of oil) which have been discovered and proven productive during the last several years have been discovered by geophysical methods.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Board April 1, 1938.

The meeting was called to order by President Grehan with the following present: Godat, Nelson, Williamson, Hill and J. M. Todd by invitation.

The minutes of the previous meeting were read and approved.

A number of names were presented for non-payment of dues. The Secretary was directed to write to these members, and if no response was received, to drop them.

Mr. Todd discussed some of the phases of the coming A. S. M. E. meeting in the spring of 1939 and pointed out some of the advantages of a concurrent meeting with the Louisiana Engineering Society.

After some discussion it was voted to rescind action of the previous Board meeting, subject to the findings of a committee composed of Godat, Hill, Rhodes. This committee to meet with a committee from A. S. M. E. to carefully consider all angles of a concurrent meeting. The findings of this committee to be reported to the Board.

A letter from Mr. Todd was presented asking the Society to consider the proposed revised building code. A committee as follows was appointed to review the matter: John Klorer, Chairman; E. S. Bres, Donald Derickson, B. S. Nelson, J. H. O'Neill, John Riess, G. P. Rice, J. M. Todd, C. S. Williamson.

The Secretary was directed to write to Commissioner Skelly asking that the Commission Council delay approval of the proposed code until the committee had had an opportunity to study the proposed revisions.

A. M. HILL, Secretary-Treasurer.

Minutes of the Regular Meeting of the Society, April 4, 1938.

The meeting was called to order by First Vice-President Godat with 70 members and guests present.

The minutes of the previous meeting were read, and the report of the Chairman of the Employment Committee.

Mr. Todd, Chairman of the Legislative Committee, spoke briefly upon what had been done in connection with the proposed licensing law.

An announcement was read concerning a lecture course to be given by Prof. Derickson on "Moment Distribution Applied to Concrete Building and Bridge Frames." These lectures will be given under the auspices of the Portland Cement Association.

The speaker of the evening was Dr. Ross C. Purdy, General Secretary of the American Ceramics Society. The title of his paper was "Ceramic Art, Technology, and Engineering." He traced the development of the ceramic industry in this country and stressed the fact that American products were of superior grade in many instances.

After some questions from the audience, the meeting adjourned to the collation.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Board of Direction, April 22, 1938.

The meeting was called to order by President Grehan with the following present: Cappel, Godat, Nelson, Stewart, Williamson, Hill.

The minutes of the last meeting were read and approved.

The following was passed: As a result of the findings of the joint committee of Louisiana Engineering Society and the Local Section of American Society of Mechanical Engineers, be it moved that the 1939 meeting of the Louisiana Engineering Society be held concurrently with the spring meeting of the A. S. M. E. on February 23, 24, 25, 1939. The program of the concurrent meeting to follow in general the recommendations of the joint committee as set forth in their report.

The Chairman of the General Committee on Arrangements of the L. E. S. will be instructed to work with the A. S. M. E. committee.

The Secretary was instructed to immediately advise the local section of A. S. M. E. of the action of the Board.

Chairman Godat of the Committee on General Arrangements of the Annual Meeting held in January submitted a very complete report on costs and activities. The cost was below the appropriated sum for the event.

An attractive bound volume containing sample letters, press notices, etc., which had been prepared by Publicity Chairman Guidry, was presented, forming a valuable addition to our Annual Meeting record.

Mr. Cappel outlined some plans in connection with membership activities as Chairman of the Membership Committee.

Mr. Nelson spoke briefly on the prospects of the coming technical papers as Chairman of the Technical Papers Committee.

There being no further business the meeting adjourned.

A. M. HILL, Secretary-Treasurer.

Minutes of the Regular Meeting of the Society, May 6, 1938.

The regular meeting of the Society was held in Highland Hall on the L. S. U. Campus, Friday, May 6. A delicious buffet supper was provided by the Baton Rouge Committee headed by Chairman Wallace. The supper-meeting started about 7:15 P. M. with 100 members and guests present.

Dean Lassalle acted as toastmaster and introduced a number of those present. The address of the evening was by James McMillen, Professor of Library Science at Louisiana State University. His topic was "Library Service to and for Engineers."

The meeting then adjourned to witness demonstrations in connection with the students' Engineers Day.

A. M. HILL, Secretary-Treasurer.

Minutes of a Special Meeting of the Society, Held May 10, 1938.

The special meeting was called to order at 8 P. M. in the Convention Hall of the St. Charels Hotel. About 115 members and guests were present.

President Grehan explained that the purpose of the meeting was to discuss the proposed law for licensing professional engineers. President Grehan asked that any interested persons present enter into the discussion, as it was not limited to members of the Louisiana Engineering Society.

Mr. Todd, Chairman of the Legislation Committee, reviewed the proposed law, copies of which had been mailed to members of the Louisiana Engineering Society, and the founder society members of this state.

As the proposed law was reviewed, paragraph by paragraph, questions were asked and answered, and a few minor changes made by vote of those present.

At the close of the meeting it was voted that the Legislation Committee be empowered to steer the bill through the present legislature.

A rising vote of thanks was given to the members of the Legislation Committee, and particularly to Mr. Todd.

The meeting then adjourned to the collation.

A. M. HILL, Secretary-Treasurer.

ACTIVITIES OF LOCAL SECTIONS

President,
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1st Vice-President,
A. J. NEGROTTO

2nd Vice-President,
N. E. LANT

Secretary-Treasurer,
J. A. McNIVEN

STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

Special Meetings at
call of President

On June 13th a joint meeting of the Section with the Louisiana Engineering Society was held at the St. Charles Hotel, in New Orleans, with over 200 members and guests present.

In the absence of President W. H. Rhodes, M. A. S. C. E., the meeting was presided over by Mr. A. J. Negrotto, Vice-President La. Section. The speaker for the occasion was Mr. Hampton Reynolds, M. A. S. C. E., Chairman of the New Orleans Development and Planning Commission, who gave a most interesting talk on "Past and Proposed Public Works Improvements in the City of New Orleans".

The Section announces that the recipients of its award of Junior Membership in the Parent Society, to outstanding senior civil engineering students at Louisiana State and Tulane Universities, are: Jack S. Burk, of Tulane, and Ernst A. Bullington, of L. S. U.

Many members of the Section are advocating the nomination of Col. Edw. S. Bres, of New Orleans, as a Director of the American Society of Civil Engineers for District 15, which comprises the States of Louisiana, New Mexico, Texas and those members residing in Mexico.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

JUNE, 1938

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PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XXIV. AUGUST, 1938 NO. 4

CONTENTS

EDITORIAL NOTES AND COMMENT

Again!! The great Disraeli once said, "Better than knowing when to seize an opportunity is to know when to forego an advantage."

Our Legislative Committee has recently had ample cause to test this wisdom.

For the nth time, now, attempt has been made to put the whole engineering profession in Louisiana on a par with that of some forty other states. And for the nth time developments subsequent to the introduction of such legislation seemed to indicate that the better part of wisdom dictated withdrawal of such effort.

Truly, the engineering profession presents an anomaly. In mass straight-thinking, the engineers are not exceeded by any other group of men on the face of the earth. In mass action, however, they are about as effective as a canary trying to

sing bass. We repeat what we have said many times before—as a group, the engineers can organize everything but themselves.

At the request of the Society, a hard-working Legislative Committee spent endless hours and energy whipping into shape a satisfactory bill for the registration of professional engineers. Ample opportunity was given to all engineers and other interested persons to assist in the framing of a really progressive bill. Many suggestions were offered and included. Many hours were spent by the committee and open meetings of the Society were held in order to embody all constructive criticism. Finally, just before the meeting of the Legislature, all kinks had apparently been ironed out. The bill was submitted with the statement that it embodied the best collective thought of the profession as a whole. Admittedly the bill could not meet the views of all individuals one hundred per cent since by its very nature it was the composite thought of a great many. Nevertheless, it was the best compromise on which all could seemingly agree and was a long step forward for the profession in Louisiana. All individuals were asked to support the measure for the good of the profession as a whole. The bill was introduced. And then the fun began.

The bill was attacked from the outside by several self-centered interests. But worse than this, and more insidious, was the destructive boring from within by members of the engineering profession itself—engineers whose interests are apparently so self-centered and outlook apparently so narrow that the doctrine of "the greatest good for the greatest number" seemingly carried no weight at all.

The bill could probably have withstood opposition from the outside, but when the matter took on the complexion of lack of enthusiastic and active support from the inside, there was nothing else to do but withdraw the bill.

The Society owes a debt of gratitude to the hard-working Legislative Committee and its able Chairman, Mr. Todd, for the fruitless labor and discouraging grief in connection with their work—all caused by the fact that engineers as a group seem constitutionally unable to present a solid front on anything which affects the good of the profession as a whole. This

is only another and effective example of a "house divided against itself." And the cost to the Society has been about $200.00 for this past trial.

The Annual Golf Tournament. June 15 will go down in history as the finest golf tournament ever held by the Louisiana Engineering Society.

Ideal weather enticed some eighty members and guests for golf, while eighteen pitched horseshoes and ninety attended the buffet supper and entertainment. All present, both young and old, enjoyed the entertainment immensely.

Dave Stewart, with a low net of sixty-two, won the Society trophy, and also had a seventy-four for low gross prize. C. S. Williamson, Jr., won the President's Flight with a low net of sixty-seven.

The committee in charge of the tournament was composed of C. E. Peirce, K. P. Kammer, J. J. Bulliung, H. Fletcher, Ole K. Olsen, S. V. Applewhite, S. E. Hottinger, J. M. Todd, A. J. Naquin.

President B. H. Grehan congratulated the committee on the splendid way the tournament was handled. Congratulations were in order, too. The committee worked long and hard on the tournament. Their labors were well reflected in the enjoyment of everyone present.

New Members. We welcome to the Society the following new members:

Wilbert L. Argus. Junior. Graduate Tulane, C. E. 1936. '36-'37 Magnolia Petroleum Co. as Assistant Engineer. September, 1937, to date, Sales Engineer, New Orleans Public Service.

John C. Baine, Jr. Member. Graduate Tulane, M. E. degree 1927. Engineer and Inspector of Equipment from 1927 to 1935. Superintendent of Equipment 1935 to date, New Orleans Public Service.

Norman L. Davidson. Member. With Ingersoll Rand Co. 10½ years..

Howard W. Gleason. Member. C. E. from Tulane in 1933. Engineering experience with Modjeski, Masters and Case, Public Belt R. R. June, 1937, to date, with George J. Glover Construction Company. Engineer on Market Street and Times-Picayune additions.

John A. Glover. Member. Assistant Superintendent for the George J. Glover Company for 7 years, doing principally civil engineering work.

Edward I. Cowan. Non-Resident Member. Experience includes engineering work with American Telephone Company on transmission line, United Engineers & Constructors of Philadelphia past five years, and at present with Gaylord Container Corporation Pulp and Paper Mill Devision, Bogalusa, La.

James P. Henderson. Member. Engineering experience with Babcock & Wilcox Company since 1910. Since 1929 District Erector for B. & W. and A. M. Lockett & Co. Address: 1627 S. Carrollton Avenue, New Orleans.

Isham W. Mann, Jr. Junior Member. Graduate Alabama Polytechnic Institute, 1934. Engineering Draftsman U. S. Naval Gun Factory, Washington, D. C. June, 1937, to present, Sales Engineer, A. M. Byers Co. Address: 411 Lowerline Street.

George H. Menefee. Junior Member. Two and one-half years experience in steam power generation work, at present with Wintete & Stevenson as Chief Draftsman and Diesel Consultant. Address: 2226 Canal Street.

Eugene C. Schultz. Member B. E. in M. & E., Tulane, 1930. Engineer, Equipment Department New Orleans Public Service 1930-34. General Engineering with New Orleans Public Service Inc., now Assistant Superintendent Automotive Equipment, New Orleans Public Service.

Robert M. Seago. Member. Electrical Construction with Phoenix Utility June-July, 1927. From August, 1927, to date, with Power Division, Electrical Department, Market Street Generating Station as Engineer.

Adam S. Trowbridge. Member. Graduate Cornell University 1930. Engineering experience with Western Electric Company, Standard Oil Company, Weston Dodson & Co., Black & Decker Co. Now Assistant Superintendent Dibert, Bancroft & Ross, Ltd., New Orleans.

Weather and Rainfall. In this issue we print an article on weather and rainfall in and about New Orleans. Its author is Mr. Alfred Theard. Mr. Theard is both a charter member and an honorary member of this Society. As one who has spent his whole life in the service of the city in connection with its sewerage and drainage problems, Mr. Theard speaks with authority.

The sewerage and drainage problems of this city, because of their peculiar nature, are linked indissolubly with weather conditions in this area. Mr. Theard's analysis of weather conditions and particularly as they apply to this area, are both interesting and entertaining. His article in this issue well repays reading.

Help Our Advertisers. The advertisers of any publication contribute largely, if not entirely, to its support.

You are urged, therefore, as a member of the Society interested in its welfare, to support as far as possible the advertisers in the Proceedings. Not only are you urged to do this yourself, but to prevail upon the other members of the Society to do so, too. A little team work on the part of the membership in this direction can not but have a beneficial effect upon the Proceedings.

Pay Your Dues Promptly. Not all of us put off paying our dues because we haven't the money.

We frequently put off paying them because it isn't physically convenient to do so—we haven't a stamp, or an envelope, or our check book isn't handy or some other trivial reason. Subconsciously, we feel that the amount is so small that the Society could not possibly be embarrassed by its non-receipt. When *nearly all* of us do so, however, practically all of the income of the Society is involved and the embarrassment becomes acute.

The officers are doing a tremendous job in improving the Society. Won't you co-operate by paying your dues NOW?

Voice from rear seat of taxi: "I say, driver, what's the idea in stopping?"

Driver: "I thought I heard some one tell me to."

Rear Seat: "Drive on. She wasn't talking to you."

PAPERS AND DISCUSSIONS

WEATHER AND RAINFALL

By Alfred Theard *

(Read before Louisiana Section A. S. C. E., January 12, 1937.)

About three weeks ago I was called up over the phone by your genial President and asked to give a talk to the members of the Society, and our guests, on the occasion of this meeting.

The subject was left to my own selection but, of course, it must be a technical one.

My whole career as an Engineer has been devoted to the one specialty of Drainage, Sewerage, and Water Service, and, while it has proven the daily study of my life, I can not bore you again with a recital of these sanitary utilities. I had to find some other thing to talk about, even if the subject I have selected forms essentially a part of the study of the drainage of our city.

In our city, with its semi-tropical climate, where changes of temperature of 30 to 40 degrees in less than twenty-four hours are recorded, I have thought that a short recital of facts concerning our local rainfall, its causes and its consequences, would prove of interest.

New Orleans is situated sufficiently close to a vast body of water to be classed as a coast city, and to be subjected to its atmospheric rules. Surrounded by an absolutely plane country, without protection by mountainous elevations, it is, indeed, interesting to compare actual records, inherent to atmospheric and climatic conditions, with those established by science and applicable to regions similarly situated.

I shall try, as briefly as possible, to explain some features of our rainfall which have come under my personal notice during the several years of my connection with an office where a correct and reliable continuous record has been made for 43 years; prefacing these remarks with the definition and explana-

* Member. General Superintendent, Sewerage & Water Board of New Orleans, La.

tion of the principles and general laws accepted as the result of scientific investigations.

This may prove instructive to some, and it has enabled me, in some instances, to make comparisons between our own records and the generally accepted theories, and to draw conclusions as to their correctness and applicability to our local conditions.

The scope of the subjects which I will necessarily mention is so vast that I have not attempted to amplify or explain the general laws enunciated. I will, therefore, state in a general way, the accepted theory of the cause of rainfall under its varied forms, a few phenomenal records established, and some local data in which we are concerned. In describing the phenomena which are the primary causes of atmospheric disturbances, it will be necessary to define and explain briefly, radiation, evaporation, condensation, mists, fogs, dew, frosts, snow and hail; and I have taken the definitions quoted from the best recognized authorities.

All phenomena noticeable in the atmosphere are referable to the action of the sun, for, as Professor Stewart says, "If the sun were blotted out from the sky, a cold lifeless uniformity would rapidly take possession of the whole surface of the globe."

These atmospheric phenomena are, therefore, divided into two classes, daily phenomena and annual phenomena, or those referable to the revolution of the earth on its axis, and those dependent on its revolution around the sun.

The first and most important of the daily atmospheric changes is that of the temperature, to which all other can either directly or indirectly be referred.

The gaseous envelope surrounding the earth is composed of two atmospheres, quite distinct from each other: an atmosphere of dry air and an atmosphere of aqueous vapor. Dry air is always a gas and its quantity remains constant, but aqueous vapor does not continue permanently in the gaseous state and the quantity present in the air is, by the ceaseless process of evaporation and condensation, constantly changing.

If the aqueous vapor remained permanently unchanged in the atmosphere, or were not liable to be condensed into clouds

or rain, the mixture would become as complete as that of the nitrogen and oxygen of the air. The equilibrium of the vapor atmosphere, however, is being constantly disturbed by every change of temperature; by every instance of condensation, and by the unceasing process of evaporation.

Aqueous vapor is constantly being added to the air from the surface of water, snow and ice; from moist surfaces, and from plants. The rate of evaporation increases with an increase of temperature, because the capacity of the air for vapor is thereby increased.

The atmosphere can only contain a certain definite amount of vapor according to the temperature. When, therefore, the air has its full complement of vapor, or when, in other words, it is saturated, evaporation ceases. Evaporation is greatest when the air is dryest, and least when the air is nearest the point of saturation. Currents of air remove the moisture and substitute dryer air over evaporating surfaces, and evaporation is much more rapid during wind than in calm weather.

Air expands under diminished pressure, its temperature naturally falls, and it approaches nearer to the point of saturation and becomes moister. It contracts under increased pressure, its temperature rises and becomes dryer and recedes from the point of saturation.

On clear and calm nights, the temperature of the earth's surface is lowered to the dew point, and when this point is reached the aqueous vapor is condensed into dew.

This cannot happen in cloudy weather because the clouds prevent the escape of heat by radiation; nor in windy weather because the wind continually renews the air in contact with the earth's surface. When the temperature is at or near the freezing point dew becomes frost. Radiation is the constant interchange of heat among bodies exposed to each other. When one body receives more heat than it radiates, its temperature becomes warmer; when, on the contrary, it radiates more heat than it receives, its temperature is lowered.

Radiation from the molecules of the earth's atmosphere toward the cold regions of space, the simple expansion of the air of ascending currents, the mixing of cold air with air that is warm and moist, and the cooling of the air in contact with

the surface of the earth, when its temperature has been lowered by nocturnal radiation, are causes that lower the temperature of the air.

When on clear and calm nights, owing to terrestrial radiation, the temperature of the objects on the earth's surface is reduced to a certain point; the aqueous vapor is condenced into dew on their surfaces.

Mists and fogs are visible vapors, floating in the air near the earth's surface; and clouds are visible vapors at a considerable height.

These visible vapors are formed by whatever lowers the temperature of the air below the dew point.

All storms are essentially the same, differing from each other only in their dimensions, intensity or the degree in which the moisture is condensed into visible vapor.

Whirlwinds, water-spouts, tornadoes differ radically from cyclones. The largest tornadoes are of so decidedly smaller dimensions when compared with the smallest cyclones as to admit of no shading of the one into the other.

Cyclones take place under conditions which involve unequal atmospheric pressures or densities at the same heights of the atmosphere, due to inequalities in the geographical distribution of temperature and humidity, but whirlwinds occur where for the time the air is unusually warm or moist, and where consequently temperature and humidity diminish with height at an abnormally rapid rate. Cyclones are thus phenomena resulting from a disturbance of the equilibrium of the atmosphere considered horizontally, but whirlwinds and tornadoes have their origin in a vertical disturbance of atmospheric equilibrium.

Hail, snow and rain are simply the manner and degree of precipitation accompanying storms. All hail is connected with whirlwinds more or less developed, and it is when the hail storm is one of the phenomena attendant on the tornado or on a great thunder storm that it assumes its most destructive form.

The vapor carried aloft by the gyrations of the tornado is, below a certain height, condensed into cloud and rain, but above that height into snow. If the rain drops formed below be carried into the snow region by the powerful ascending cur-

rents of a tornado, and be kept suspended there a little while, they become frozen into hail. If they become separated from the gyrations of the tornado, they are precipitated to the earth as hail stones of clear ice.

Snow, in bulk ten or twelve times lighter than water, takes the place of rain when the temperature is sufficiently low to freeze the condensed moisture in the atmosphere.

When, therefore, owing to a cold current appearing in some part of the atmosphere, the vapor which it contains cannot continue in its gaseous state, it becomes condensed, and, in accordance with the conditions under which this condensation has been accomplished, rain, snow or hail is produced.

Whatever tends to lower the temperature of the air below the dew-point is a cause of rain. It is, therefore, to the winds we must chiefly look for an explanation of the rainfall and the principles of this connection are these five (5) as given by Professor Stewart.

(1) When the winds have previously traversed a large extent of ocean, the rainfall is moderately large.

(2) If the winds at the same time advance into colder regions, the rainfall is largely increased because the temperature is sooner reduced below the point of saturation.

(3) If the winds though arriving from the ocean have not traversed a considerable extent of it, the rainfall is not large.

(4) If the winds even though having traversed a large extent of ocean, yet on arriving at the land proceed into lower latitudes or regions markedly warmer, the rainfall is small.

(5) If a range of mountains lies across the onward path of the winds, the rainfall is largely increased on the side facing the winds and reduced over the region on the other side of the range because the air on the windward side is suddenly raised to a greater height by crossing the range, the temperature is further reduced by expansion, and a more copious precipitation is the result. On the other side, the air descends to lower levels, becomes gradually dryer, and the rainfall diminishes with the descent.

In this latitude, where the rainfall is distributed through all months of the year, and where snow covers the ground for

only a small part of the year, if ever, the mean temperature of the soil equals that of the air.

Precipitation is irregular in time, particularly in the area in and around New Orleans. Mr. W. F. McDonald of the U. S. Weather Bureau says: "The rainiest hour of the year at New Orleans, judged from the sum of traces and measurable rains, is the hour from noon to 1 p. m. in July when rain conditions enter the record on about one day in four. The hours between 1 and 2 p. m. in July and between noon and 2 p. m. in August show a frequency of the rain conditions nearly as great as in the hour first named. Measurable amounts are most frequently recorded between 1 and 2 p. m. in August, and nearly as often in the same hour in July."

"The driest hour of the year is between 1 and 2 a. m. in July, when frequency of the rain condition (including traces) is less than 2 per cent. Frequencies of only 1 per cent for measurable rains are recorded in several of the early morning hours in June, July, and August, when measurable rains are at minimum frequency."

The bias of hourly distribution of rainfall towards the warmer time of the day marks the summer thundershower type of precipitation, which reaches its highest perfection in August, but which is distinctly dominant from May through October, and shows its beginnings in April. The lack of other types of rainfall in August probably accounts for the slight comparative reduction in the total of rainy hours in that month as compared with July and September.

Although more rain falls within the tropics in one year, yet the number of rainy days is less than in temperate climes. Thus, in an average year, there are 80 rainy days in the tropics while in the temperate zones the number of days on which rain falls is about 100. Here in New Orleans, about 120 days.

At Cherrapungee, in the Khasia Hills of Assam, 615 inches fell in one year, and there are several places in India with a fall of 190 to 280 inches.

The rainfall at Paris is 22 inches; at London, 22.50 inches; at New York, 43 inches; at San Francisco, 22 inches; at Sitka, Alaska, 90 inches; at New Orleans, 56 inches.

In the United States and Canada to east of longitude 100 degrees west, the feature of the rainfall is the comparative equableness of its distribution; annual rainfalls exceeding 50 inches being restricted to very few districts and rainfalls below 20 inches being very scarcely met with. The regions where rainfall exceeds 50 inches being Florida, the lower basin of the Mississippi, and the Atlantic Coast.

The summer winds of the southeastern coasts are southerly, and, as they are anti-cyclonic in their origin and have in their course traversed some extent of ocean, they arrive well, but not super saturated, and pour down a heavy rainfall along the coast and for some distance inland from Louisiana to West Virginia. In June and July the southeastern winds attain their maximum force and persistency, and the rainfall at the same time reaches its maximum.

Observations have established a diurnal curve of rainfall showing the minimum to be between 6 and 10 a. m. and the maximum between 2 and 6 p. m., these agreeing with the phases of the barometric pressure; the maximum period being near the time of minimum pressure.

Rainfall, as we perceive it when it reaches the earth's surface, is formed of rain drops varying in size from 1/50 to 1/10 of an inch in diameter, in accordance with the intensity of the storm. In mists and fine winter rains the drops vary from 1/50 to 1/20 of an inch, and in heavy summer showers average about 1/10 of an inch in diameter.

Of all the species of water, that precipitated in the form of rainfall is the purest, but it is susceptible of offering the greatest variations. No water which occurs in nature is pure in the strict chemical sense of the term. Experiments related by Prof. W. R. Nichols of the examination of 73 samples of rain water collected on a farm in the open country, in England, demonstrate positively that rain water, however free from suspended particles of foreign matter which are visible to the eye, invariably contains, in solution, substances which in their ordinary condition are solids or gases. The rain which falls, even in the open country, is far from being chemically pure. The dust which floats in the air often contains minute organized bodies—some rod-like, other globular—which prove to be cap-

able of self propagation and which are endowed with motion, at least under certain conditions. These naturally occur in rain water, particularly in that which falls in the beginning of a shower, the water being purer naturally as the rainfall progresses, and its purity is proportionate to the severity of the storm.

Centuries ago, when sciences were less cultivated than they are today, several extraordinary rainfalls were recorded. We are told of rains of sulphur, of sand, of cinders, of grasshoppers, of frogs, of blood, of stone, etc., all of which are easily explained by the various colored dust or the insects whirled through the atmosphere by the very swift storm that caused the rain.

The method of recording our local rainfalls is far ahead of the old system of open basins, and improvement in that is keeping pace with that of other branches of science.

To secure accurate information regarding rainfalls, I think the system at present being operated by the Sewerage and Water Board is very near perfect.

Seven self-registering rain gauges of the tipping bucket type which give the time distribution of rainfall measured in hundredths of an inch are distributed intelligently over the territory where the observation is desired. They are kept in continuous operation under the care of reliable observers, and the daily records, automatically registered, are carefully filed at the central office. This, to an interested student, affords the best opportunity for investigation and comparison, showing conclusively that when accurate observations are required, one gauge, centrally located, will not give correct results for a large extent of territory. Thus we see, not at one, but very nearly at all times of the year, an excessive rainfall recorded at one gauge and no rain at another; or, again, a wonderful difference in the intensity and duration of the same storm at gauges comparatively close to each other.

Another feature of importance in establishing stations for observing and measuring rain storms should be uniformity in the elevation of the several gauges. This feature I do not think was considered owing to the flatness of this territory. However, when one considers that a rain drop increases in size

while it is being precipitated by absorbing the humidity of the atmosphere through which it descends, one must conclude that a difference in the elevation of the recording instruments, however small, must necessarily cause a relative increase in the amount recorded. I have, for this purpose, established the elevation of the several gauges at present in use in this city, and for purposes of comparison have fixed their elevation to the nearest foot above mean gulf level.

For all storms of uniform intensity, it is undeniable that the lower gauges will uniformly give the larger record, however small and appreciable the difference in elevation.

This proves the assertion that to obtain similar results, even when the gauges are near each other, it is absolutely essential that they be in the same horizontal plane. I assert, after a careful perusal of the general records that these peculiar features are repeated for at least seventy per cent of the storms.

An inspection of the record sheets for the several storms leads me to conclude that, for an absolutely accurate record of rainfalls over any territory, no gauge should be expected to serve for a district exceeding a superficial area of more than three (3) square miles, or a gauge, to be considered reliable in its record, should occupy the center of a circle with a radius or not more than one mile, or 5,280 feet.

I have endeavored to establish a percentage of the storms of different intensities as compared with the total storms for each year, with the following results:

Rainfall	from	.01	to	.25 inch	56 per cent.
"	"	.26	"	.50 "	12 per cent.
"	"	.51	"	.75 "	8 per cent.
"	"	.76	"	1.00 "	9 per cent.
"	"	1.01	"	1.50 "	9 per cent.
"	"	1.51	"	2.00 "	4 per cent.
"	Over	2.00		inches	2 per cent.

The number of days on which precipitation is recorded average annually 120.

It is to be noticed that rainfalls in excess of 1 1/2 inches are quite unusual and that 2 inches or more are recorded very seldom, indeed.

Another very important feature is the average rate of precipitation and the average duration of the maximum rate.

The rate of precipitation is, in many instances, very great in comparison to the total rainfall—a rate of 2.5 inches per hour being quite frequent with a total rainfall of 0.5 inch or less. The greatest rate of precipitation which has been recorded is 7.2 inches per hour, or .12 inch in ten minutes, on July 4, 1894, and I find no longer record of any storm with such a maximum rate lasting over ten minutes, five minutes being the average duration of the maximum rate.

One of the most surprising features, when a comparison is made of the averages of the records of the Weather Bureau, is the steady decrease in the totals, during the past 66 years.

What is the cause of this steady deficiency? The improved instruments for recording rain storms are a comparatively recent invention, and, no doubt, the records obtained sixty years ago were somewhat imaginary, and not so thoroughly accurate. But, then, how can we explain the extraordinary downpour of 1888 (August 18-19)? Is it because the atmospheric conditions of our climate are steadily changing? Is our Southern territory becoming colder? These are questions which I acknowledge are submitted with the hope that some one will answer them. I do not pretend to be able to explain them even after the careful study of the general principles governing the laws of atmospheric changes recited at the beginning of this paper.

But, after all, what is an inch?—a small insignificant inch of rainfall? Very few people realize what it means, and you will pardon me if I cite here a few illustrations. For a city, with a superficial area of say 50,000 acres, like New Orleans, one inch of rainfall means very nearly 1,361,250,000 gallons of water. A portion of this water was, a few years ago, gathered from the roofs of 60,000 houses, and carefully stored away in cisterns, but cisterns have been practically done away with, and what is now stored in tanks or cisterns is a negligible quantity.

This is, as you see, a large total amount precipitated on the superficial area of our city, and what proportion of this is to be taken care of by our drainage system, forms the subject of a few interesting remarks.

Run-off is that portion of the precipitation which, falling upon an area, flows over or through the earth to a water course and out of the watershed. Precipitation, of course, is the source of run-off, but many different factors affect the amount and rate of run-off from a given watershed. A portion of the water is absorbed by the soil; some of this passes through the soil into drainage canals; some is evaporated from the soil; some is absorbed by plants and trees, and a portion passes over the surface of the ground to a water course.

The rate and amount of run-off are affected principally by the time, the amount, and the distribution of the precipitation. Also the topography, the size and shape of the given area, its degree of development, the prevailing temperature, and the artificial drainage.

A special factor, strictly of a local nature, in this city and its peculiar soil formation, is seepage.

In our spongy soil, the rate of run-off varies in proportion to the condition of prolonged drouth or rain which precedes any rainfall, especially in the unimproved sections. This was an essential factor to be considered in fixing the rate of run-off which must be taken care of by the drainage arteries for each area.

The effect of these several factors upon the amount and rate of run-off is not constant, but is continually changing.

Combining the records of areas possessing uniform characteristics to produce a single record for the total number of years covered makes possible long range prediction of excessive precipitation.

In an article published last year by Professor L. R. Griffith, Oregon State College, he remarks that: "many engineers will claim that too many variables and unknowns exist to permit the accurate computation of run-off from a given drainage area."

In another recent article by C. H. Eiffert, Chief Engineer of the Miami Conservancy District, Dayton, Ohio, it is said that: "Because of these variations, it is rather obvious that the run-off problem is not susceptible of solution by means of strictly mathematical formulas." "It is also obvious that the principal factor in determining the amount of run-off—must

be precipitation.—For these reasons, our first step in estimating run-off must be to make the best possible use of precipitation records.''

I am positively inclined to agree with these views, but many standard methods of computing the run-off expectancy from any watershed have been known. The one most commonly used, perhaps, is the Burkli-Ziegler Formula.

Q=Quantity of water reaching culvert in Cu. Ft. per Sec.
R=Maximum rainfall in inches per hour.
M=Drainage area in acres.
S=Average slope of drainage area.
C=Coefficient depending upon character of development of drainage area—Rural 0.25.

To facilitate the solution of this formula, a chart has been prepared by Griffith-Nutter which can be read very easily.

Far be it from me to criticize or belittle the value of this or other formulas, but I do think that the method used by the Engineers who prepared the report on Drainage of New Orleans, 1895, was by far more accurate than the application of any formulas in preparing a standard diagram establishing the quantity of run-off for New Orleans, for different areas, based on the degree of improvement for the respective areas.

These Engineers thought that the best bases for calculating future run-off are measurements of stream flow extending over a long period of time for any particular area under consideration.

If such records are available, the amount and rate of run-off can be estimated closely, unless the physical features that affect run-off from the area are materially changed.

Such records were available when the run-off was calculated for the city by the Drainage Engineers.

The size of a watershed is an important factor in determining the volume of run-off originating on the area, for, approximately speaking, volume of run-off varies directly with the size of the area, but generally the rate of run-off per unit of area decreases as the size of the watershed increases.

In the case of this city, special areas were separated as tributary to the existing respective draining stations. Their topography was carefully noted, and flumes were established

in the outfall canals for the purpose of obtaining uniform sections through which all the water lifted by each machine would pass. Across the top of each flume, a suitable wharf was placed for the observer, provided with a strong substantial rail, graduated to facilitate the use of a meter. The gauging was performed with a Price Current Meter.

The gauging of the discharge from each machine was carried on very carefully for nine consecutive months, day and night. All the varying conditions were carefully noted, recorded, and tabulated, and, from this information, was plotted a curve, which for all our run-off calculations, became a standard for this city, both for the storm and daily flow.

The rate of maximum run-off fixed for areas was:

DENSE	80	PER CENT.
MEDIUM	60	" "
SPARSE	40	" "
RURAL	20	" "

That this standard curve was accurate has been proven a thousand times in fixing, by it, the capacity of our Drainage Pumping Stations which are adequate for an efficient service.

In comparing the results obtained by reading the Griffith-Nutter Chart, and the curve or chart fixed by the Drainage Engineers, I find that the rate of run-off varies only by a very slight difference, almost negligible, which confirms my opinion that both charts are correct, with a slight variation of the coefficient "C" 0.23 in one and 0.20 in the other for rural areas.

In this article I have quoted Prof. Balfour Stewart, Prof. L. R. Griffith, Prof. Eiffert, Prof. Nichols, Highway Magazine, Encyclopedia Britannica, Encyclopedia Moderne, Winston's Encyclopedia, Mr. W. F. McDonald, and his able assistant, Mr. R. A. Dyke, of the U. S. Weather Bureau.

If your nose is close to the grindstone rough
And you manage to keep it there hard enough,
Ere long you will find there is no such thing
As brooks that babble and birds that sing.
Three things will all your world compose,
Just you, the stone, and your darned old nose.

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Board of Direction, June 7, 1938.

President Grehan called the meeting to order in the library of Stanley Thomas Hall with the following present: Godat, Pegues, Stewart, Williamson, Hill and Todd by invitation.

Chairman Todd of the Legislation Committee outlined the work accomplished by the group, and stated some of the objections put forth by some organizations to the licensing law, represented in Senate Bill 94.

Chairman Todd advised Senator Duke that the committee would rather have the bill killed than exempt telephone and public utility employees from the registration law.

A letter was submitted by Chairman Todd, addressed to the members of the Legislature. The Board approved the multigraphing of the letter, and sending a copy to each member of the Legislature.

The Board passed a resolution approving the action of the Legislation Committee. It was also voted that the Chairmen or Presidents of local sections of founder societies send letters to the proper committees in the Legislature, urging the killing of House Bills 500 and 566.

The Secretary was directed to write to those Board members not present to hold themselves in readiness to go to Baton Rouge to present arguments in favor of Senate Bill 94.

There being no furher business, the meeting adjourned.

A. M. HILL, Secretary-Treasurer.

Barber: "Was your tie red when you came in here?"
Customer: "No, it wasn't"
Barber: "Gosh!"

St. Peter was interviewing the fair damsel at the pearly gate. "Did you, while on earth, indulge in necking, petting, smoking, or dancing?"

"Never," she retorted emphatically.

"Then, why haven't you reported sooner?" said St. Peter. "You've been dead a long time."

Cop: "Who was driving when you hit the car?"
Drunk (Triumphantly): "None of us; we were all in the back seat."

ACTIVITIES OF LOCAL SECTIONS

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W. H. RHODES

1st Vice-President,
A. J. NEGROTTO

2nd Vice-President,
N. E. LANT

Secretary-Treasurer,
J. A. McNIVEN

STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

Special Meetings at
call of President

The following committees have been appointed by President W. H. Rhodes, and approved by the Board of Directors, to serve during the year 1938:

Committee on Licensing of Engineers:

Prof. Donald Derickson, Chairman, 1311 Henry Clay Ave., New Orleans.
W. H. Rhodes, Canal Bank Bldg., New Orleans.
F. N. Billingsley, 409 Interstate Bank Bldg., New Orleans.
Col. E. S. Bres, 388 Broadway, New Orleans.
J. T. Bullem, P. O. Box 1692, Monroe, La.
H. B. Henderlite, State Highway Commission, Baton Rouge, La.
J. Klorer, 526 Carondelet St., New Orleans.
J. H. O'Neill, 637 Lowerline St., New Orleans.
Prof. B. W. Pegues, La. State University, Baton Rouge, La.
John Riess, 808 Carondelet Bldg., New Orleans.
I. W. Sylvester, City Hall, Alexandria, La.
G. P. Rice, 902 Baronne Bldg., New Orleans.

Scholarship Awards Committee:

Col. E. S. Bres, Chairman, 388 Broadway, New Orleans.
Prof. Donald Derickson, 1311 Henry Clay Ave., New Orleans.
Prof. B. W. Pegues, La. State University, Baton Rouge, La.
A. S. Hackett, 511 Whitney Bank Bldg., New Orleans.
F. P. Hamilton, 408 Walnut St., New Orleans.

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B. Dornblatt, Chairman, P. O. Box 254, New Orleans.
H. F. Favret, 4837 St. Claude Ave., New Orleans.
O. L. Fontenot, 1090 Government St., Baton Rouge, La.

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I. W. Sylvester, City Hall, Alexandria, La.
E. E. Shutts, P. O. Box 653, Lake Charles, La.
J. R. Wendt, Sr., 2320 Kleinert St., Baton Rouge, La.
A. H. Guillot, 1423 Adams St., New Orleans.

Aims and Activities Committee:

Col. E. S. Bres, Chairman, 388 Broadway, New Orleans.
F. N. Billingsley, 409 Interstate Bank Bldg., New Orleans.
G. P. Rice, 902 Baronne St., New Orleans.

Committee on Annual Meeting:

Ole K. Oleson, Chairman, 833 Howard Ave., New Orleans.
Two members to be appointed by Mr. Olsen.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

AUGUST, 1938

"PATRONIZE OUR ADVERTISERS"

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THE PROCEEDINGS
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Suite 422 St. Charles Hotel

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PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XXIV. OCTOBER, 1938 NO. 5

CONTENTS

EDITORIAL NOTES AND COMMENTS

Age and Youth. At our meetings it is frequently noticed that the older members and the younger ones segregate themselves into age groups. This is usually done, of course, because any member of an age group knows those of his own age better than those of the other group.

Such self-segregation, however, is an error. Each group has something the other needs. The older members and the younger ones should see to it that they intermingle freely. From the older men the younger men can reap the benefits of wide experience, varied outlook, wise judgment, calm deliberation, and well considered but unhesitating action.

From close contact with the younger members, the older ones may be helped to retain all of the attractive outlook that goes with youth—enthusiasm, vigor, action, and freedom from the shackles of precedent. In other and plainer words, a free

THOMAS T. DUNN. Non-Resident. Age 34. C. E. graduate L. S. U. 1925, 1925-27 R. G. Lassiter Co. Highway Const.; 1927-date Great Southern Lumber Co. and Bogalusa Paper Co. At present: Chief engineer Gaylord Container Co. P. O. Box 1146.

MARIO R. GUELL. Non-Resident. Age 34. 1928-29 surveyor with 1st Dist. Engineers. Finished in the E. E. at L. S. U. in 1935. McWilliams Dredge Co. as maintenance electrical engineer. July, 1937, to date, with Gaylord Container, Chief draftsman. 502 Avenue E, Bogalusa.

RALPH S. HOLT. Member. Age 34. Blast furnace and coal by-product chemist Woodward Iron Co., Woodward, Ala., 5 years. Asphalt inspector and general testing and inspection So. Test. Lab., Birmingham. Asphalt and steel inspection and supervision of field tests, Pittsburgh Test. Lab. Present N. O. manager. 816 Howard Avenue, New Orleans.

PAUL J. LETZ. Non-Resident. Age 47. 1912-14 Chainman-rodman J. S. Burk, C. E. of Houston, Texas., 1915, transitman. 1916 rodman City Engineering Department, Houston. 1917-25, surveyor and assistant engineer, M. M. Barnard, Crowley, La. 1925-34 princpal assistant engineer. 1934-date, surveyor in private practice. 203 E. 8th Street, Crowley.

EDWARD A. MCLELLAN. Junior. Age 25. Six months U. S. Waterways Exp. Station at Vicksburg. 2½ years A. M. Lockett & Co. as estimator and salesman. 1430 State Street.

G. G. AURIOLES received the Junior Membership Award from Tulane, graduating in Chemical Engineering in June, 1938.

A. J. FERGUSON received the Junior Membership Award from L. S. U., graduating in Mechanical Engineering in June. 1938.

JACQUES L. FORTIER transferred from Student to Junior Member.

JOHN E. MOREHISER, transferred from Student to Junior Member.

Report of Legislative Committee.

Mr. B. H. Grehan, President,
Louisiana Engineering Society,
New Orleans, Louisiana.
Dear Mr. Grehan:

I desire to report to you the activities of your Legislative Committee in the past session of the Legislature.

Between the Annual Meeting and the opening of the Legislature your Committee spent considerable time and effort in drawing up a proposed engineers' registration law which was introduced into the Legislature by Senator Claude Duke under the caption Senate Bill No. 94.

Immediately with the filing of this bill in the Legislature and the consequent publicity automatically given, certain elements within our own ranks agitated for changes in spite of the fact that they had all been invited to sessions of your committee during the progress of drawing up this bill. Objections were also filed by the local groups of practical refrigerating engineers, and licensed operating stationary engineers.

Your committee met with the last two named agencies in an effort to clear up the thinking to the effect that the proposed bill did not in any way affect these two groups. These groups, however, were unwilling to accept your committee's statements and concessions with the ultimate result that through the American Federation of Labor opposition to Senate Bill No. 94 was generated.

With reference to the opposition from the members of the professional engineering group, your committee attempted to meet these objections and revise the bill in committee. Certain elements of this group seemed insistent upon no change at all in the present engineering legislation, with consequent opposition in the Legislature to the passage of Senate Bill No. 94.

There was also opposition to Senate Bill No. 94 by the railroad interest, the public utilities interest, and the communication of telephone company engineers.

The result of the above opposition was the withdrawal of Senate Bill No. 94 by your committee.

In addition to this bill (Senate Bill No. 94), your committee also interested itself in House Bill No. 500, which was an effort to change the present civil engineering registration bill, and your committee was successful in having this bill withdrawn. We also interested ourselves in House Bill No. 566, which was an amendment to the present architectural registration bill, and was successful in having this bill changed to meet the objections of the professional engineering group. This bill was subsequently defeated due to other agencies than your own committee.

Your committee also attempted to keep contact with general matters of legislation affecting the engineering profession, but due to the uncertainty of information available, we are unable to report whether or not we have been completely successful in protecting the interest of the professional engineering group.

Respectfully submitted,

JAMES M. TODD, *Chairman,*
Legislative Committee, La.
Engineering Society.

PAPERS AND DISCUSSIONS

BOATS

By Andrew J. Higgins, Sr.*

Read before the Society September 12, 1938.

The English word "boat" is of Saxon origin. Much of our language is of such origin—for naming the common as well as the vulgar thing. But it is not to the Saxon we are indebted for the development of the boat. The Greeks had a word for it; so had people of older cultures—races whose history is, in part, legend.

Any form of craft, obtaining flotation, other than from the buoyancy of the material used, will be referred to under the general or broad term, "Boats."

Undoubtedly, primitive man first achieved his need and his desire for water transportation by his use of a log, no doubt selected for its buoyancy. We can conceive his next step for progress to be the securing of a number of these united in the form of a raft. Then, by mental process, or by accident, his adventure of discovery that a log, irrespective of its buoyancy, if properly hollowed, and in proper position, would give greater carrying capacities for himself, his fellows, and his tackle. We can imagine his efforts to secure propulsion by pole, or paddle, and visualize his elation when by accident or design, he contrived and secured propulsion by use of a vertical plane opposed to the wind. Picture the acclaim accorded our ancestor when he discovered that by manipulation of this sail, he secured directed movement, and directed progress through the water. Another monumental discovery, the paddle, properly held, contributed additionally to secure this result.

It might be interesting, by research or by conjecture, to trace early Mans' progress, but time and space compels skipping through the ages.

By accepting history as well as by legend, we owe much to the Phoenicians, not only for the arts of naval architecture,

*President, Higgins Industries, Inc., New Orleans.

navigation, and explorations, but also for the art of trade, and for the cultures acquired from them.

The urge for comfort, as well as a place in the Sun, is the impetus to evolution and the pursuit of the ultimate.

The study of the development of the boat and the art of navigation is tantalizingly interesting. The use of ships and boats and the art of their building and their use is an index to the rise and fall of nations, and to the progress for civilization, (used presently the word is a misnomer). It has been said that the progress of nations, or peoples, has been proportionate to their military arts, and this applies to their knowledge and use of metals, whether for defensive or offensive armament. Likewise, the use of metals in the fabrication of boats contributes to the strength of those nations in their naval arm.

There is something about boats—their construction and operation—that intrigues all. I doubt if there is one of you here but has at least had the urge to build a boat. Everyone has his "dream-boat." The interest in boats and the love for them is not confined to age, or sex. The girl-child will fight her brother for a toy boat. The boat is an elemental thing. It would be exhaustive to pursue this subject in its many angles. Its many commercial needs and applications are infinite. The use of boats for pleasure and health is beneficial. The use and enjoyment of a boat develops the refinements and the courtesies. Some have said that we human beings in our desire for rapid transportation are affected by a disease, "Motormania." Possibly the quickest way of bringing this point home would be to sketch a series of incidents said to have occurred:

Several gentlemen, leaving their club for the garage, accidentally brushed, or bumped into two other gentlemen likewise bent. Proper apologies and courtesies were exchanged. Shortly thereafter, the two parties, perhaps by coincidence, were on the same boulevard enroute by automobile to the yacht club. The near car honked and honked and the occupants, under their breath, called the driver and the occupants of the car ahead—well, you know what! And, by the same token, those in the car ahead passed their "compliments" to the occupants of the rear car. Finally, the forward car having begrudgingly

moved over, the rear car passed. Such glares and gnashing of teeth, and such restrained rage! In fact, the incident was the major topic of conversation occurring in the two cars until they reached their destination. Again, by coincidence, the two parties chanced to meet on the dock where both their boats awaited. Ah, what a difference now! They were considerate, polite, and courteous. Yes, among yachtsmen it is usually the "Alphonse and Gaston" act of courtesy. The same people who are enraged at fancied discourtesies in a car, disturbing themselves physically and mentally in their driving, are different beings in their boats.

The designing of a ship or a boat requires broad training; technical, theoretical, and practical experience. To conceive a vessel, the use and the purpose of its employment must be understood. The cargo to be carried, whether bulky or of concentrated form, with resulting weight; the passengers and their accommodations; the distance to be travelled and the obstacles of navigation; the means and methods and form of propulsion—all these govern the selection of the size and hull form, and control or circumscribe the serious designer.

We Americans have just pride for our accomplishments in naval architecture and construction, in the performance of our ships and the seamanship of our crews,—the intelligent and courageous officering of our ships; all these factors contributing to the efficiency of our American conceived and American built ships, in war, or trade.

Can there be an American with soul and pride so dead as not to thrill at the recollection of our naval victories, in peace and in war. The clipper ships unequalled in beauty and in speed—those wonderful creations of McKay; and the Baltimore clippers, with their long, racy hulls and towering masts. These were in the glorious age of our Merchant Marine. In speaking of the Baltimore boats, I am reminded of that Chesapeak built boat, the three-masted schooner named "General Armstrong," commanded by Captain Samuel Reid.

I have often wondered why our histories, and particularly the histories in schools do not give prominence to one of the most outstanding exploits in American History. While this

historical incident may be foreign to the purpose of this talk, I would not follow my own inclination, if I did not call it again to your attention, for there is already too much of a tendency in these times to be cynical and inattentive of those things that should thrill and should make us proud of our American citizenship. I am referring to the exploit of this Baltimore boat in what has been called "The Affair of Fayal."

My excuse for referring to this is to support the statement that boats and ships influence or have affected the destiny of nations. Were it not for the accomplishment of the crew and captain of the Baltimore privateer, the "General Armstrong," in the harbor of Fayal, in the Azores, the map of this continent might look quite different, and had it not been for that "Affair," the Battle of New Orleans might never have been fought as such.

We, here in this section, are all quite conversant with the historical facts leading up to Jackson's victory on January 8th, 1815, but some of us have overlooked the fact that Admiral Sir Thomas Cochran's naval expedition sailed from Portsmouth, England, early in September of 1814, for the Gulf of Mexico, for the purpose of capturing New Orleans. This was to lead to the British control of the Mississippi Valley. The first division of this expedition was a squadron consisting of three war vessels—the 74 gun ship of the line, named "Plantagenet," commanded by Capt. Robert Floyd—the Frigate "Rota," of 38 guns, commanded by Capt. Philip Summerville, and the Brig "Carnation," of 18 guns, under the command of Capt. George Benthan. These ships were manned by 2,000 sailors and marines. These war vessels were escorting a number of merchantmen, several of them armed, as transports carrying British veterans, experienced in the wars against Napoleon. On the arrival of this British fleet at the harbor of Fayal on September 25th, 1814, on entering the harbor, they sighted Capt. Samuel Reid with the Yankee privateer, the "General Armstrong," with a crew of 90 men, and oh what men. The "General Armstrong's" armament consisted of eight 9-pounders, and one long-gun mounted on the bow. Fayal was a portuguese neutral harbor, but our British cousins frequently found

it convenient to overlook such details. When called on to surrender, Capt. Reid put his ship nearer to shore, and set out boarding nets, and cleared his ship for action. The British brig, "Carnation" moved in to prevent escape of the Yankees. Capt. Reid withheld his fire, observing the neutrality of the port. Only when fired on, did he rake the "Carnation," causing its withdrawal beyond the range of the long-gun. That nights, boats were lowered from the British fleet filled with armed men. (We are indebted for the account of the "Affair" to an English officer. Usually nationalism will prejudice or color such a narration). By midnight, all boats were arranged for the attack, but when approaching, three boats were sunk by the American's long-gun. The others put alongside and the boarding nets were hacked to pieces. The British sailors and marines clamored over bow and stern, shouting "No quarter." **They were cut down to a man.** The British lieutenant who led this expedition was the first man killed. Out of some 30 boats, only 2 survived and managed to get back to the warships, with a hand-full of men. The next morning the Portuguese Governor (with the usual Portuguese observation of neutrality, where a presumably stronger nation is concerned) sent a peremptory command to Captain Floyd to stop hostilities in the harbor. Capt. Floyd replied that if he were hindered, he would treat Fayal as a hostile port. Before the close of day the British ships had warped themselves into enclosing positions, and bearing on the "General Armstrong," poured their broadsides into her. The privateer's men replied in kind, and again disabled the "Carnation." Of course, such a fight could have only one ending. Three vessels against one much smaller than their smallest. Nine cannons against 150. Ninety men against 2,000 upwards.

Captain Reid scuttled the "General Armstrong" and set her afire, where she burned to the water's edge. Landing his crew, they stormed and seized the Portuguese fortress on shore and drove off the British fleet. The "Carnation" was damaged so badly, and all the British ships had lost so many men that the squadron returned to England to refit;—thus delaying Admiral Sir Thomas Cochran's expedition against New

Orleans. As a result, the Admiral's expedition arrived adjacent New Orleans four days after Gen. Jackson had reached the city for its defense.

Now as to boat construction;—for ourselves, we have set what we believe are high standards. At the expense of repetition, it is our spirit and intent to furnish the best and the most for the least. We do not like to be circumscribed to a cost or price limitation. Uses and circumstances being almost infinite, it is our purpose and incentive to design and build a boat properly engineered and constructed for a specific purpose. In accomplishing this, and in evolving a particular and possibly an unusual type of boat that qualifies for various uses, under various circumstances, we consider we have made some contribution to the boat building art.

To the type of boat you have seen in various stages of construction in the workshops, we have given the name "EUREKA" Model. The distinctive part of the elements of the design of the EUREKA, is what we term the "Spoon-bill bow," with somewhat radical hull formation in the underwater amidship section, this molding into a semi-tunnel stern conformation. The general conjecture about an unconventional bow is that it would result in excessive and severe "pounding." But, such is not the case. You may have noticed that in the formation of this spoonbill bow, the design incorporates an angularity or what is commonly called in boat parlance, "deadrise." Instead of the boat in its progress through the water (as would be the case with a boat of conventional bow) splitting the water, the "spoon-bill" bow rides over it. In the case of rough water the forward section of the bow catches and diffuses the approaching wave. The action of the boat in the bow section is that of passing over and through the water, effecting a softening of impact, even when the boat is operated at high speed in rough water.

It is sufficient to say that contrary to results previously obtained by other designs and constructions, we obtained unusual speed from an unusually heavily built boat. We obtained also unusual control and maneuverability in ahead and reversing actions.

Naturally, it is gratifying to know that we have evolved a boat that can do such things. Dependability, load-carrying ability, stability, seaworthiness, shallow-draft, towing qualifications, are all expected, and necessary, from this type of boat, plus unusually good control and maneuverability. Many naval architects have preconceived ideas that no type of boat can be controlled and steered when in reverse. I ask you to note particularly the fact that this type boat can be steered accurately astern, and can be controlled when in reverse, either to starboard or to port. These boats also have another unusual, if not weird, action, in that they can be maneuvered, and in fact, spun in very narrow quarters. They can actually make broadside landings, or in boatmen's parlance, "Spot landings." We ask you to note that where the boat is slammed up onto the bank two-thirds of its length, under its own power, it reverses direction and slides off. This characteristic of the boat permits its use in narrow ditches, for we can turn these boats in a ditch one-third in width the length of the boat. One of these boats was deliberately run over a log at a speed of approximately 23 miles per hour. A few hours later this same boat was loaded aboard steamer, and a careful inspection revealed no damage.

As to the mechanics of building boats of steel, the determination and selection of dimensions and weights of structural members and plating are along conventional ideas and accepted engineering principles. In so far as boats of our own design and construction are concerned, we subscribe to the desirability of incorporating longitudinal framing in addition to transverse framing. This is particularly desirable in such sizes and types of boats where unusual speed performance is desired. The close centering of both transverse and longitudinal framing permit the use of lighter plating. We have observed that procedure in the fabrication of steel vessels, new-comers to the practice of electrical arc welding, follows by habit practices and preconceptions of placement of framing, as was their practice with rivet construction. The structures secured by electric arc welding permit the designers to secure maximum strength with minimum weight. It is regretted that the needs of com-

petition imposed on most builders cause them to be concerned with rapid construction, thus preventing necessary attention to correct welding methods. I will not here discuss the "modus operandum" to secure a perfect welded structure, free from distortion of plates and framing caused by heat. It is superfluous to mention that freedom from this is secured by proper design, correct materials, and efficient supervision over carefully trained craftsmen, using proper tools and observing correct technique. Most builders of metal structures shy away from the fabrication and use of wrought iron. This otherwise most excellent metal must be more carefully handled, not alone in the welding, but in the cutting, the bending, and shaping of plates. The characteristics of wrought iron are quite different from those of steel and make its use more difficult. The builder who bases his calculations on the fabrication of a wrought iron hull from his experience with the use of mild steel will complete his first job a sadder but wiser man.

The conscientious builder is concerned with the preservation of the metal structure he fabricates. No benefit is obtained in the use of galvanized members and plating unless another form of protection is provided where the original protection is desroyed during fabrication. A chain is as strong as its weakest link, and so a galvanized structure is only as durable as those sections of the hull which have lost the galvanic protective coating during the course of working. There is considerable debate as to the best procedures for the preservation of the different metals used in boat construction. Much can be said, but little has been recorded on the various causes of corrosion and the protective methods to be employed against them.

For our part, we personally are prejudiced against the removal of mill-scale, or the preparation of metal surfaces by sand-blasting. Our observations lead us to believe that there are electrical forces charged into the structures—that there is a weakening and a loss of surface and strength in the metal itself by the action of sand-blasting. We have observed that hulls so treated give evidence of harmful electrolytic action evidenced by the pronounced effect on compasses installed

therein. If it would be of interest, we consider it no revelation to state that we have developed a process for treating structures, either of steel or of wrought iron, both framing and plating, with an acid composition. In this "pickling" process, we remove mill-scale or bloom. We follow this treatment with the ues of an inhibitor and neutralizer, and thereafter wash down the plate with fresh water. In most cases, it is not convenient to further protect the plating after this treatment while building, the hinderances being the handling, cutting and the welding. After fabrication, we repeat this treatment, and by the use of heat remove the moisture from the surfaces and cells of the metal. We have convinced ourselves, at least, with the idea that we thus remove useless dust and waste from the cells of the metal exposed on the surface. After the heat treatment of the plate, the primer containing lead or other preservative pigment is applied. With a correct and proper application of the process we find this form of protection very successful. We have actually determined from visible evidence that the priming vehicle gives penetration and impinges the lead or other preservative pigments into the pores on the surface of the metal.

I previously mentioned the word "corrosion." People using boats in or around salt water find it convenient to attribute the effects or corrosion to such exposure, but this is not at all times the case. The most destructive form of corrosion is initiated by the breakdown or inversion of the metal, primarily by electrolysis.

In the case of the construction of boats of wood it has been my fortune to follow both as a business as well as a hobby the portion of Botany that I might refer to as "Treeology." Self-evident truths, exclaimed, are often expressive. So it has been said "Only God can make a tree." One of his most successful efforts was the creation of a particular species of tree, which grows in the Philippine Archipelago. Latin names do not stick, so I will designate this tree by its common, descriptive name,—Dense, Long-fibred Red Lauan. This wood is frequently erroneously described under the general name, "Philippine Mahogany." As there are many different species of Coni-

fers on this continent, from the Firs of the Pacific Coast, to the Pines of the South, and as there is a marked difference between our Southern Pines;—for instance, our splendid, close-grained, Long Leaf Yellow Pine, and the much poorer, and less useful Pine, our short-leaf Pine, or "Loblolly Pine,"—so is there a marked difference in the many different species of the so-called Philippine Mahoganies. Eminent among them is the wood to which I refer, the Red Lauan, with its long, tough, fibrous grain. This tree grows thickly in dense forests. The strong and healthy tree, luckily placed as to sources of fertility, survives and reaches its place in the Sun. (A simile could be noted here to Man, and Men as nations.) It is the immutable law of the survival of the fittest. The study of the growth of this Red Lauan tree is an interesting subject in itself; in fact, the miracle of the growth of any tree is an interesting and absorbing subject. You engineers can figure and can achieve many things, but nothing as perfect.

Whenever you see a towering, majestic tree—and I might mention that it is a sad reflection on us, that we so infrequently now have this opportunity—consider and estimate, if nothing else, the weight of the substance that has been drawn from the ground and which has passed through the various circulatory structures of this tree, to the leaf, its chemical laboratory. Consider also the return of the sustenance properly converted for the growth in height and girth, which is required for its progress to reach maturity. Consider the tons of moisture that are required in a season to defy the laws of gravity in its circulation through the structures of the tree. Many trees have attributes and similarities to human beings. Take for instance the Oak. This wood reminds one of a pompous, irascible, nasty individual—boasting of his strength, but refusing to contribute his strength to a unity. It will not "stay put," be retained, or hold in marriage, in its point of affixment even with other members of its own specie, let alone other species of woods. From its acidity it not only destroys other woods in their bearing on it, but destroys itself. When it is necessary for us to use Oak, in certain forms of construction, we endeavor to neutralize this acidity and other destructive elements therein in order to make it a useful, integral

member of a structure. We do this by artificial means, extracting the tanic and other destructive acids without breaking down the cell structure of the wood. We endeavor to replace and fill the cell structure with preservative oils, and to kill fungi and bacteria with an application of a mineral substance. We also see to it that there is a suitable, good, and thick insulation on the surface of Mr. Oak, when he is harnessed, has a fixed bearing on other members, either of his own or other species of wood.

To refer again to the dense, long-fibred Red Lauan, this wood grows in a climate without seasons, and as the wood grows against a terrific compression of an unusually thick bark (sometimes as thick as 8 inches, in a matured tree) there results a wood which is not characterized by the annual ring growth. Ring growth is common in trees growing in seasonal climates. The annular ring is made up of summer wood, and winter wood. This makes it convenient to ascertain the age of such tree. Red Lauan, selected for density and long, stringy fibre, we believe is most superior for use as planking on boats, and is useful elsewhere. It is equal, if not superior, to other woods available for selection. I cannot pass from the subject of the selection of woods and trees without a tribute to a wonderful wood that is fast disappearing. It is already a problem for the conscientious boat builder to secure clear, all heart, straight grained, and close-grained **Long Leaf Yellow Pine.** Its equal for longitudinal and structural members, for lasting qualities, tensile strength, and for the good retention of fastenings, has not yet been found. I feel that you engineers will consider that I would be neglectful if I did not refer to the use of Cypress for use in boat construction, for in this section of the world, this wood has been most frequently and commonly used, particularly for planking. Clear, all-heart, well seasoned Cypress is becoming scarce, and expensive. When it was available and cheaper, its use was occasioned by the circumstances of its availability. Due to its porosity, it continually increases the weight of the boat up to maximum point of saturation. Cypress is a soft wood, it is not the best wood for the retention of fastenings, particularly the thread of a screw. In our boat construction we go to great efforts to secure the most suitable

and durable wood, with due thought for its service and preservation, and protection in its particular point of implacement. "A chain is as strong as its weakest link." So it is in the case of woods. Any piece of wood is only as strong or as suitable as any defect which may be in that piece—unless such defect can be removed or corrected without compromise of the strength of the unit piece. In the nature of things, sap does not grow next to pitch, or the center of the tree. Conscientious boat builders in designing and building for durability must see that there is no sap on any member, and particularly on the planking.

In connection with the mechanics of construction, we have to consider fastenings. We are frequently appalled at the improper selection of the type and method used. Some builders with an air of superiority and conviction boast where their structures are copper riveted. They do this even when this retention is in Oak. We also note with amusement that several large manufacturing firms building stock boats state in their advertising that they use brass screws. I recently had occasion to ask a factory superintendent of a large boat building company why they used brass screws. He received the question with a great deal of astonishment, and asked me if I expected them to use black iron. When I suggested that they use a bronze screw of proper alloy, and again, use such fastenings properly protected with a preservative grease compound, he asked me what was the difference. I considered the simplest answer was to advise him, "30 years or more."

We use bolts of pure iron, and with the best form of galvanic protection. But where maximum strength, with limitation of diameter is required, we use Monel metal. We trust that when the steel people have a uniform product, stainless steel will replace Monel metal at a lower cost.

Whereas our principal business is the building of boats, we like to think ourselves as designers and engineers; particularly power plant engineers. Of necessity, we make many installations in the boats we build, but we make an equal if not greater number of installations of power plants in addition. We cater to the engineering, that is, the understanding of the need and

use of power. We are concerned with the cost of fuels; the extent and period of operation; the question of loads; the working conditions under which the power plant will operate; the availability of skilled operators, and the requirement for service. We are **not** primarily concerned in just selling a power plant or an engine, but are concerned in assisting our client in selecting the best engine for his purpose.

As we build boats for arduous use, it is our problem to select from engine manufacturers engines of such design and characteristics as will give the dependable performance which is to be expected of the boat. The greatest exposure of a marine engine is to the inadequacies and deficiencies of the water cooling for these engines. Boats operating in shallow, sandy, muddy and trash-filled waters frequently have the inlet for cooling water clogged; the usual type of water pump wears; and the accumulation of sand and silt within the water-jacketing of the engine builds up an adobe or brick from the clay, sand, and fibrous substances in the water—these accumulating on the protuberances of valve guides and hangers, and filling the jacketing. They become the greatest cause of marine engine failure. We believe we would be conservative in attributing marine engine failure in 90% of cases to the deficiencies and inadequacies of water circulation. Cooling of Diesel engines is even more vital than gasoline engines, particularly with the higher speed type of Diesel engines. The unusually high exchanges of heat within the Diesel, particularly the high speed type—and the fact this type of engine is equipped for electric starting, requiring generators and storage batteries of high voltage and large amperage, make this engine particularly exposed to the inversion of its metal structure from electrolysis. For this and other reasons we have devoted ourselves for a number of years to developing protective Closed Fresh Water Cooling for marine engines. We have developed several types of these systems. We have found out much by the old reliable method of trial and error. We have also found by observation and comparison that unquestionably the recirculation of fresh water in marine engines retards if not prevents destructive electrolytic actions in the engine, as well as on the hull structure when the hull is of metal. Electrical engineers

here present will confirm that a moving volume of water, particularly salt water, affords a splendid conductor for electricity.We have observed that where this salt water leaves the engine, it has destructive action on the metal of the engine, and we have observed destructive electrolytic action also on metal hulls. Where the engine has the protection of a Closed Fresh Water Circulation System, such damages are not found.

As I have several bets outstanding as to the length of this and desiring to compromise these bets and with some regard for your patience, I will relieve you, but must again express my pleasure at having you all here with us. I hope you will enjoy yourselves. I thank you.

"Frequent water drinking," advised the specialist, "prevents you from becoming stiff in the joints."

"Yes," said the co-ed, "but some of the joints don't serve water."

The weighing machine was out of order, but no notice to that effect had been posted. An unsuspecting fat lady clambered on and inserted a penny. Among the curious bystanders was an inebriated gentleman intently watching the dial. The scale registered 75 pounds.

"My heavens," he whispered hoarsely, "she's hollow."

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Board, July 1, 1938.

The meeting was called to order about 8 p. m. with President Grehan in the chair and the following present: Godat, Nelson, Williamson, Hill.

The minutes of the last meeting were read and approved.

The report of the Golf Tournament-Smoker Committee was read and vote of thanks expressed to the committee for their splendid work.

The report of the Building Code Committee was read and it was voted that the committee be thanked for their work. It was asked that the President confer with the Chairman of the Building Code Committee to determine the advisability of writing to the Mayor and Commission Council concerning the findings of the Louisiana Engineering Society. It was also asked that the recommendation be made to the Council that an engineer be delegated whose sole purpose would be to study the code and review the criticisms offered. This should lead to the re-enactment of the Building Code so as to satisfactorily comply with the developments in the building industry.

In connection with membership plans, about five hundred and sixty names will be transferred from cards to a mailing list, which will enable members of the Membership Committee to make contacts.

The report of the Library Committee was accepted, and it was asked that they continue the study of the library situation.

C. W. Rieker was appointed as Chairman of the General Committee on Arrangements for the Annual Meeting in 1939. C. J. Peirce, Jr., was appointed as Vice-Chairman. The Chairman will select his own committee.

There being no further business, the meeting adjourned.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Board, September 9, 1939.

The meeting was called to order by President Grehan with the following present: Cappel, Rhodes, Nelson, Williamson, Hill.

The minutes of the last meeting were read and approved.

Chairman Cappel outlined the work done by the Membership Committee. It was suggested that membership lists of the parent societies be reviewed for possible prospects.

It was asked that Chairman Rieker of the Library Committee be asked for further plans in connection with the library.

Chairman Todd's report of the activities of the Legislative Committee in connection with the law for registering professional engineers (Senate Bill No. 94) was presented. It was voted to have this letter read at the meeting of September 18, and to print it in the next issue of the Proceedings. A letter of thanks is to be sent to the committee.

The American Society of Civil Engineers asked the Board for its endorsement of the Model Law. The matter will be referred to the Legislative Committee.

Hearty approval and cooperation was voiced in connection with a campaign letter to keep New Orleans clean, sponsored by the Association of Commerce.

The meeting then adjourned.

A. M. HILL, Secretary-Treasurer.

Minutes of the Regular Meeting of the Society, September 12, 1938.

The meeting was held at the plant of the Higgins Industries, 1755 St. Charles Avenue. Previous to the formal opening of the meeting an inspection of the plant was made.

About 8:30 the meeting was called to order by Vice-President Godat with about 100 members and guests present. This meeting was held jointly with the local section of the American Society of Mechanical Engineers.

The minutes of the previous meeting were read, then the report of the Legislative Committee was presented.

The meeting was then turned over to Chairman Karl P. Kammer of the American Society of Mechanical Engineers.

Mr. James M. Todd spoke on the spring meeting of the A. S. M. E. in February, 1939, in which the Louisiana Engineering Society will cooperate.

Mr. Kammer then introduced the speaker of the evening and host, Mr. A. J. Higgins, who read a paper "Boats and the Boat Industry." A movie was shown following the paper, showing the ease of maneuvering a boat of the "spoon-bill" type.

The members then made another trip through the plant, and witnessed the remarkable progress that had been made during the space of giving the paper, upon a boat which was under construction.

This second trip was followed by a delicious buffet.

Those present were indebted to Mr. Higgons for such an interesting meeting. Mr. H. L. McLean was instrumental in making the detailed arrangements and was thanked in the course of the meeting by Chairman Kammer for his services in this connection.

A. M. HILL, Secretary-Treasurer.

ACTIVITIES OF LOCAL SECTIONS

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W. H. RHODES

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A. J. NEGROTTO

2nd Vice-President,
N. E. LANT

Secretary-Treasurer,
J. A. McNIVEN

STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

Special Meetings at
call of President

On October 21, 1938, the fall meeting of the Section was held in Baton Rouge at which time an inspection trip of the new Mississippi River Bridge, now under construction near Baton Rouge, was made through the courtesy of Mr. N. E. Lant, Member A. S. C. E., bridge engineer of the Louisiana Highway Commission and the Kansas City Bridge Company, who have the substructure contract.

Following the inspection trip a buffet supper was given at the University Country Club. Following a brief meeting of the Louisiana Section and the Student Chapters of the American Society Civil Engineers of Louisiana State University and Tulane University, a paper was read by Mr. E. L. Erickson, Member A. S. C. E., assistant bridge engineer of Louisiana Highway Commission, who has charge of construction of the new bridge, on "The Design and Construction of Foundations of the Mississippi River Bridge at Baton Rouge." A brief discussion of the paper followed. There were about 150 members in attendance including the entire Student Chapters of L. S. U. and Tulane.

The Section announces that its annual scholarship awards to the outstanding civil engineering student will be continued this year to Mr. Clem B. Binnings of Tulane University and Mr. Volney F. Landry of Louisiana State University.

In addition to the inspection of the Mississippi River at Baton Rouge several other inspection trips have been arranged by both the L. S. U. and Tulane Student Chapters. On October 14th Mr. Loyd G. Frost, of the Louisiana Geodetic Survey, spoke to the Tulane Chapter on "Benefits of Precision Surveying."

Col. Edw. S. Bres, of New Orleans, has been nominated Director of the American Society Civil Engineers for District 15, comprising Louisiana, Texas, New Mexico and Mexico. He will take office at the annual meeting of the Society in New York in January, 1939, for a three-year term succeeding Mr. E. P. Arneson of San Antonio, Texas.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

OCTOBER, 1938

"PATRONIZE OUR ADVERTISERS"

INDEX TO ADVERTISEMENTS

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LOUISIANA ENGINEERING SOCIETY

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PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

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CONTENTS

EDITORIAL NOTES AND COMMENT

Merry Christmas! So say we all! And in our happy salutation, let us not forget that to-day more than ever we need to contemplate quietly, fervently, and reverently the origin of Christmas.

Too much of the world has already forgotten that the ugly, festering sores of hate, persecution and greed are no part of the spirit of Christmas.

If the spirit of Christmas could only pervade all the earth —and during all the year—we would not see the nauseatingly sad spectacle in which spiritual and moral degenerates impose at will persecution, death, rape, and plunder on inoffensive human beings.

And with our wishes for a Merry Christmas, let us combine a spirit of thankfulness; thankfulness that we live in America, thankfulness that there is still an America for us to live in,

thankfulness that there is still an America in which the spirit, the mind, and the body are still free! Thank Almighty God!

And in our thankfulness, let's spread as fully and as far as we can the true spirit of Christmas, a spirit which the world so sorely needs—"Peace on earth, good will toward men." And so a prayer for unfortunates—thank God for our fortunes —Merry Christmas to all!

Our Luncheon Gatherings. In the last issue of the Proceedings, your attention was called to the fact that a system of informal luncheon gatherings had been inaugurated, with the assistance of the St. Charles Hotel. So far, those who have attended are delighted with the idea.

It is felt that more members do not join the group because they fear that these luncheons are expensive. Nothing could be further from the truth. The prices are very reasonable. A complete and satisfying lunch may be obtained from forty cents up. The *a la carte* items, also, such as soup ten cents, pie ten cents, coffee five cents are very reasonable. And understand, too, that the service is not cheap restaurant service, but the regular food and service the hotel gives its other patrons. Come to these luncheon gatherings as often as you can. You will enjoy them. These gatherings are excellent opportunities for engineers to meet each other and exchange ideas. For those who live out of town and come to the city, these luncheons are the simplest way to get in contact with some of your professional brethren.

Mr. W. H. Rhodes, Chairman of the House Committee, desires to make these luncheons as successful as possible. They can be made so only by regular and large attendance. Attend these luncheons as many days of the week as you can but do so **regularly.** Even if you can attend only one day a week, do so **every week.** There is no better way outside our regular meetings to build among our members a spirit of good fellowship and professional solidarity.

The 1939 Annual Meeting. The next annual meeting will be held concurrently with the spring meeting of the American Society of Mechanical Engineers. The date is Thursday, Feb-

ruary 23 through Saturday, February 25. Final touches are now being given to plans which will bring together engineers from all over the country. The coming meeting, combining as it does the membership of the two societies, should produce a wealth of interesting papers and discussions.

Many features have been provided. There will be a student conference for engineering students, inspection trips and plenty of entertainment—golf, an informal party and, finally, the banquet and dance, which was such a delightful affair last year.

For the ladies, the Woman's Auxiliary is providing a round of events. We are counting on last year's fair visitors to return and bring other ladies who have not yet attended the meeting.

Complete programs should soon be received by all members. Note well the dates, mark them on your calendar, and by all means plan to attend.

Some Problems in Pilot Plant Work. Elsewhere in this issue is published a discussion under the above caption. Professor F. B. Taylor of the School of Chemical Engineering, Tulane University, discusses with authority the problems of transferring processes from the laboratory to the works plant by means of the Pilot Plant. What he says comes from a background of ample experience in the research departments of large industrial corporations.

The South is a rich field for the development of all kinds of chemical engineering processes and products. Professor Taylor's paper makes interesting and profitable reading for those interested in the development of the chemical industries of Louisiana. The field of these possible future developments is almost unlimited.

The Mississippi River Bridge at Baton Rouge. Again this publication is happy to present a full discussion of another of the great bridges over the Mississippi.

The discussion this time is by Mr. E. L. Erickson, one of our non-resident members and an engineer in charge of construction on the bridge of which he speaks.

The discussion, which is published in this issue, is complete, interesting and instructive. Here is recorded in accurate, entertaining, informative and in permanent form, the record of another man's engineering conquests. Mr. Erickson's narrative is very attractive reading. May we get more like it from some of our other non-resident members.

Help Our Advertisers. There is an old saying that the greatest example of co-operation is where one hand washes the other, and both hands wash the face.

Our advertisers help us by buying space. Let's help them by patronizing them whenever the opportunity offers. Generous patronage of our advertisers is the only way in which they can get a return on their ads in these pages. The more our advertisers are patronized by our membership, the more valuable (to them and to us) our advertising space becomes.

In helping them we help ourselves much—Oh, yes we do!

To the Members Living Out of New Orleans. The Society belongs to you as much as to those who live in New Orleans. These pages are yours too. Quite frequently events occur in different parts of the state that would have considerable professional interest to all the members of the Society.

When happenings of wide professional interest occur near you, please write to the Proceedings, giving as complete information as you can, so that note of such occurrences can be made in these pages.

Personals, too, are keenly desired, either about yourself or about other members of the Society. This goes for in-town members also.

PAPERS AND DISCUSSIONS

SOME PROBLEMS IN PILOT PLANT WORK

By F. M. Taylor *

Read before the Society November 14, 1938.

The pilot or semi-works plant, which covers that part of a chemical process development which comes between the laboratory scale and the production scale of operation, occupies a position of unquestioned importance in the field of chemical engineering. The reason for its importance is this: In a large majority of cases, a chemical process involves one or more chemical reactions, and the factors which govern the chemical change involved may be few and simple or they may be many and complicated. A chemical process, though worked out very carefully in the laboratory, cannot be depended upon to behave in the desired manner when put on production basis, and because of this, it should be carried through its "growing up" very carefully and conservatively. Research men and operating men, alike, have learned, sometimes through bitter and costly experience, that conservativeness in this transition stage, the pilot plant or semi-works stage, greatly reduces the chance of failure when the process is finally put on a commercial basis.

Only in a very few exceptional cases should it be permissible to transfer a process directly from the laboratory to production basis. Herman C. Cooper, Factory Experimental Apparatus. Chem. Met. Eng. 32:426 (1925), says: "Direct transfer is a hazardous undertaking and is disliked by the average chemical engineer. Risk is lessened by extending the period of study. If it were possible to anticipate every variable that will be involved, there would be little to fear, but the average engineer prefers to admit the possibility of overlooking something and likes to proceed cautiously. As an example, every variable in the extraction of a vegetable oil was supposed to be known, and a three-ton extractor was ordered, but the operation

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worked differently on a large scale. A filter press should have been used to remove much of the oil."

What are some of the factors that make direct transfer from laboratory to production basis so hazardous?

In the laboratory the research chemist carries out his investigations almost entirely in glass. He can see what is going on. In the plant the equipment is usually constructed of metal, and the operator has to depend upon instruments, to a large extent, to tell him what is taking place within the vessel. Again, a chemist working with glass equipment is not troubled with any possible effect the walls of the flask may have on the reaction. When the same reaction is transferred to copper, iron, or steel vessels, the metal may have a catalytic effect on the speed or degree of the reaction. This may be advantageous or it may be detrimental. Then there is the problem of corrosion which is rarely encountered in the glass laboratory equipment, but which has to be dealt with in the pilot plant where chemicals are in contact with metal. Many materials of construction, such as glass-lined and rubber-lined metal equipment and corrosion resistant alloys have been developed to combat this evil, but the problem is far from being solved. Part of the equipment in the bromine extraction plant of the Dow Chemical Company at Wilmington, N. C., has to be renewed every six months, since no metal or alloy within the price range of the process has yet been found to resist the corrosion. It is often the case that corrosion tests made in the laboratory are not substantiated under plant conditions. A metal which withstands corrosion in laboratory tests may not be resistant after undergoing fabrication. Failure usually appears in the neighborhood of punched rivet holes or where the metal has been welded. This weakness, if it exists, will be brought to light in the small pilot plant equipment, resulting in quite a monetary saving if the material of construction has to be changed.

Another factor which is likely to cause very different results in the plant from those obtained in the laboratory, is the great difference in the quantities of materials, the size of equipment, and the surfaces involved. In the laboratory the reactions of the process are carried out on the gram basis and the entire quantity of product produced in any one run prob-

ably will not exceed 500 grams or approximately one pound, while commercial production may require several tons of product per day. The large size equipment necessary to carry out the reaction on the commercial scale cannot possibly have the same ratio of volume to surface, but it isn't possible with our present knowledge to predict what effect this different ratio will have on the reaction. The addition or subtraction of heat from the reacting mass cannot be carried out at the same rate in plant size equipment as in that of laboratory size, for in the laboratory, heat is supplied either with a bunsen burner or with an electric heater. Since the equipment and the quantities of reactants are small, no part of the material can be very far from the source of heat and will quickly receive its energy. On the other hand, if the same reaction is carried out in a 500-gallon tank, even with the most efficient agitation, the particles in the center will be much farther removed from the energy source and will receive their energy at much lower rate. As an example of this, during the World War the need arose for a certain cyanogen derivative. The laboratory work proceeded smoothly with 100% yields. The equipment was enlarged and an attempt was made to produce ten pounds, but the yield dropped off to 10%. Then the order came through for 75 pounds per day. The most that could be produced was 5 to 10 pounds per day. After two months of frantic research it was found that the low yields were due to different temperature conditions and also to the catalytic effect of minute traces of impurities. Changes in the heating methods and removal of the impurities restored the yield to the 100% basis.

The purity of the reacting materials also has an effect on the efficiency of a chemical reaction. In the laboratory investigation, chemically pure reactants are usually employed, but the cost is generally too high to permit the use of this grade as raw material on the production scale. The wise research chemist will try out the reaction using the commercial or technical grade of raw material to determine what effect, if any, the impurities will have on the yield. But even if the reaction proceeds satisfactorily under these conditions, he has no guarantee that the same results will be obtained when

large quantities are involved, since the total quantity of the impurity present will be much greater, even though the percentage is the same. The pilot plant will very likely show whether or not the impurities of the cheaper raw materials will have to be removed before the process will produce a profit.

With so many factors involved in changing from small, glass laboratory equipment to large, metal equipment, a process should go through at least one pilot plant stage, and preferably more, before a large outlay of capital is made for the commercial size plant. Jasper Whiting published a paper in 1912 on the "Commercial Development of Chemical Processes" in which he outlines five different stages through which a process, being developed, should go. The larger the number of steps in the development, the greater will be the chances of ultimate success, for every time the experimental plant is enlarged, a new set of problems is encountered which must be solved before going on. The number of stages, of course, depends upon the particular process and its degree of complexity. The first stage should be as simple and yet as flexible as possible, to permit a detailed study of the operating variables. It is in this stage that the effect on the reaction of the metal walls and the impurities of the raw materials are determined, and also what materials of construction are best suited for the equipment. Here should be obtained the answers to such questions as: Does the product come up to the requirements of the market, or will provision have to be made for special methods of purification to bring the product up to commercial standard? Is the process adaptable to large scale production?

If the plans call for only one pilot plant stage, then there are other problems which must be worked out, but these can be solved more easily with a larger size experimental plant, one that is truly a semi-commercial plant. It is at this point that the engineering aspects of the process become a dominant factor in the development. The laboratory work has been carried out by a chemist and not an engineer. It was his job to work out the problems of the chemistry, but he may now be called upon to furnish additional data which might be re-

quired, from an engineering point of view, for the purpose of design. The first pilot plant stage was concerned chiefly with the quality of the product and the yield obtained when the process was transferred from the laboratory to metal equipment. Now, in designing the semi-commercial plant, provision has to be made for handling larger quantities of materials. The auxiliary equipment requirements have to be taken into consideration. The sizes of piping, pumps, and storage tanks become an important factor. Energy requirements, electrical and heat, have to be determined. These are all questions which may not have come up before, but which must be settled before the final plant is designed.

Another problem which has to be solved in the semi-commercial plant is that of labor. Operators for the new process have to be trained and some organizations use this stage as a training school for the future plant operators. However, this practice has its disadvantages, as these new men, who are generally new employees and not highly trained, cannot be expected to give the process the close attention of its originators and as a consequence much important data is missed due to their untrained observations. Some little irregularity will escape their attention, which if observed, would probably save a great deal of time and worry in clearing up some difficulty. Besides training the operating force, this stage will give a fair estimate of the size of the operating force which will be required to run the full size plant, how many men to be assigned to each piece of equipment, and the time required for each operation. Other problems which should be solved here involve the value of the by-products, if any, and the disposal of wastes, if any.

If the final plant is to consist of a number of units, then before all of the units are constructed, one complete unit should be set up and operated for a time sufficiently long to iron out whatever problems may arise in the final set-up. Insurmountable problems have even arisen at this late stage which necessitated the abandoning of a process. One of the larger producers of cellulose acetate yarn in this country was confronted with the problem of reducing the cost of acid recovery, due to the falling price of the yarn. A process was

worked out in the laboratory, carried successfully through the pilot plant stage, and finally tried out on one unit of a proposed sixty-unit plant. Here a difficulty was encountered in the separation of two liquids which had not appeared until a flow of about 200 gallons per hour was used. It could not be overcome and the process was finally abandoned.

When all of the problems which have arisen in the gradual development of a chemical process through the pilot plant have been solved, then the final plant can be designed with the assurance that the risk involved has been reduced to a minimum.

THE DESIGN AND CONSTRUCTION OF THE FOUNDATIONS FOR THE MISSISSIPPI RIVER BRIDGE AT BATON ROUGE

By E. L. Erickson *

Read before the Louisiana Section American Society of Civil Engineers at Baton Rouge, Louisiana, October 21, 1938.

Synopsis

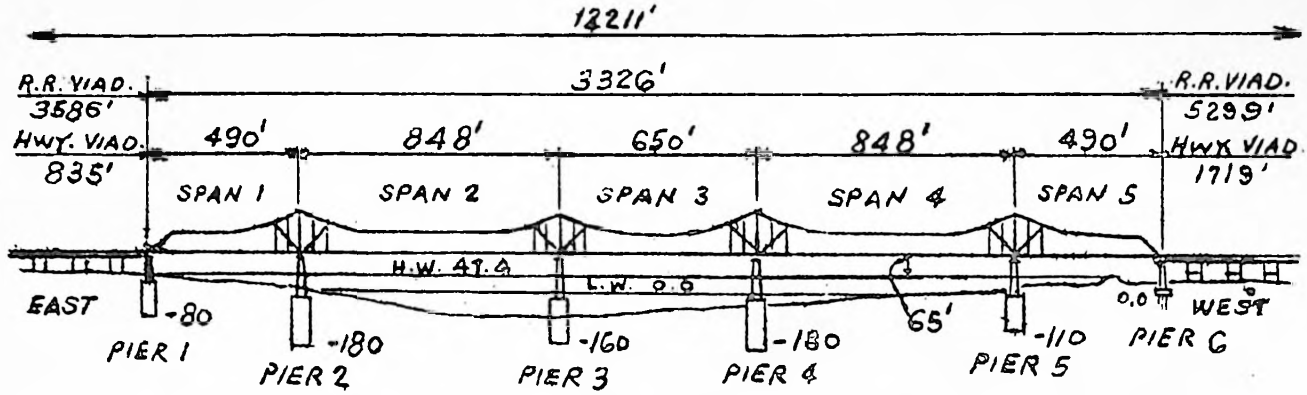
The construction of a bridge over the Mississippi River at Baton Rouge, Louisiana, presents a number of the foundation problems due to the soil formation peculiar to this lower valley. There are no rock strata within reach upon which heavy piers can be founded and danger of scour thereby eliminated. Therefore, in order to provide stable foundations for the structure, caissons must be sunk to unusual depths for that part which is in and directly adjacent to the channel of the river and piling must be driven to support the approaches. It is the purpose of this paper to describe the method of attack used in the design of the foundation structure. It is proposed further to describe the construction as it has proceeded to date.

History and Description of Project

As an introduction a brief history and description of the project is as follows:

A bridge crossing the Mississippi River at Baton Rouge has been under discussion for many years by various interests prior to the construction now under way. In 1914 a company called the Baton Rouge Bridge and Terminal Company secured a franchise and Congressional authority to construct a combined railway and highway structure. This company went so far as to have preliminary studies of the crossing, which was located at or near the present site, made by the engineering firm of Modjeski and Angier. Nothing, however, was done at this time, the promotion running into financial difficulties. For a number of years they were not to be overcome.

* Non-Resident Member. Assistant Bridge Engineer and Engineer in Charge of the Construction of the Baton Rouge Bridge for the Louisiana Highway Commission.



ELEVATION OF BRIDGE LOOKING DOWNSTREAM

In 1930 a Mr. Bovay who had arranged the financing and building of a number of privately owned toll bridges attempted to put over the Baton Rouge project, but again nothing was accomplished. The Louisiana Highway Commission was unwilling to accept the proposal made. Again in 1931 another attempt was made; this time the Missouri Pacific Railroad started the movement with the cooperation of the Louisiana and Arkansas Railroad, and the Louisiana Highway Commission. Studies of the site, preliminary plans and estimates were again made. The engineering firm of Modjeski, Masters and Chase was retained for this work. A War Department permit was obtained for the proposed structure, but the project again fell through when the Interstate Commerce Commission disapproved the railroad Company's application to enter into the construction. Still another attempt was made in 1933. At this time it was proposed as a P.W.A. loan and grant project, and was sponsored by the Louisiana Highway Commission in cooperation with the Louisiana and Arkansas Railroad Company. The engineering firm of Harrington and Cortelyou was retained to prepare the P.W.A. application, make field investigations and prepare plans. Due, however, to a series of controversies which resulted in the withdrawal of the state funds set aside for the project, another attempt to place the project under way ended in failure. In 1936 the state again provided funds through a Congressional Amendment authorizing a bond issue of which five and one-half million dollars were dedicated to the construction of the Baton Rouge bridge. These funds supplemented by regular Federal Aid Highway Funds to the amount of one and one-half million dollars, set the project off again with the resulting award of contracts in May, 1937. The surveys, plans and specifications had been prepared by the State Highway Commission.

The site of the bridge is approximately four miles north of the city of Baton Rouge, directly above the Standard Oil Company and Solvay Company plants. This site was selected for the reason that this is as close to the city as a War Department permit could be secured with over-water clearance

to provide for river navigation only. Below the site ocean-going vessels serve both of the above mentioned industries. A short distance above the bridge site there are shoals in the river which define the head of deep water navigation. The question of providing vertical clearance for ocean-going vessels was, of course, cause for much concern, as in this case it means that should this be required 135 feet above high water would be the least to be provided. On the other hand, if the structure could be built to care for river navigation only, a permit could be obtained from the Federal authorites providing but 65 feet above high water. This difference in the height of the structure can better be visualized as to its effect on the project after one is aware of the difference between high and low water levels. The river at this pont fluctuates from a low stage at elevation 0.0 MGL to a high of 47.4 MGL. Therefore, to provide 135 feet of vertical clearance above high water, a clearance of 182.4 feet would be required above the low stage. As it is, a clearance of 112.4 feet is provided over the low river stage.

The structure when completed will have a total length of 12,211 feet, of which the river crossing is 3,326 feet. The main river crossing is to be symmetrical about a center anchor span 650 feet in length with 848 feet cantilever spans made up of two 226 feet cantilever arms and 396 feet suspended span, and shore anchor spans 490 feet in length. This structure will rest on six piers, five of which are concrete caissons and one bank pier. This latter is on the west bank behind the levee, and has been placed on a pile foundation. The approach viaduct structure will have a total length of 8,884 feet, 3,586 feet in the east approach and 5,298 feet in the west approach. The foundation structure for the entire approach is set on reinforced concrete piling.

Geology

The bridge site is located in a reach of the river which has for its east bank a clay bluff and for its west bank an alluvial deposit consisting of silt, clay, gumbo and sand. The clay bank on the east rises to a height of sixty feet above mean gulf level, while the alluvial bank on the West has an

elevation of 30.0 MGL sloping in a westerly direction to an elevation of 20.0 at the end of the railroad viaduct. The east bank forms a part of the Mississippi up-lift and extends below the city of Baton Rouge. Examination of the river bank from below the city to Fort Adams, Mississippi, approximately sixty miles above, shows throughout the entire length the same materials and physical characteristics. Above the bridge site there are to be found a number of points where there have been slides and caves of considerable size. It was noted that caving banks were located generally at bends in the river where the current had worked to cause undermining. It was further noted that the worst conditions occurred where the bank reaches the greatest height. The bank study was most interesting at three points, two directly above the bridge site and another at Fort Adams. Directly above the bridge at the plant of the Mengel Company and at the bend in the river known as Scotts Bluff, there has been a caving or dropping of the bank after each high water for the past several years. This, of course, gave due cause for concern in the location and design of the bridge piers located in the east river bank. Investigation of this condition showed this caving of the clay bank caused by the cutting out of a strata of clay having quite a high sand content which was found by borings from elevation-50.0 to -60.0. It was further found that the bank was affected for only short distances or at those points where the river current headed directly into the bank. The condition of the bank at Fort Adams was the worst found. The formation there is similar to that in the vicinity of the bridge site, in that here again the east bank of the river is on the edge of the uplift and the west bank is formed by the alluvial valley of delta. One contrasting difference, however, exists, this difference being in the bank height. Here the bank rises in excess of one hundred feet above the river at low water. Here again extensive dropping and folding has occurred at a bend in the river, the movement going back from the river bank as far as half a mile. All this is mentioned to show that it has been fully realized that careful study must be given to stability of the

bluff bank at the bridge site to insure a safe and stable structure.

Borings were made during the summer and fall of 1936 at each pier location and a large number of holes were put down in the east bank in an attempt to determine the extent of bank movement in evidence above and below the bridge site for several hundred feet. These bank explorations showed conclusively that the movement in evidence was not deep seated, that is, not extending into the hard yellow clay of the uplift, but confined entirely to the silt deposit, reaching a maximum depth of forty feet. These explorations were made with a two-inch wash boring outfit owned and operated by the Highway Commission, cores being taken approximately every five feet.

In the river and on its adjacent banks two series of borings have been made, the first in 1933, when plans were prepared for P.W.A. consideration. This first series consisted of eight borings located at the then planned pier locations. They were two-inch cores and were drilled to depths of elevation -100.0 to -197.0. The second series consisted of six four-inch core borings drilled to depths ranging from elevation -250.0 to -294.0 MGL. Undisturbed samples were obtained by means of a sampling tube having a cutting edge slightly smaller in diameter than the barrel, thus reducing the amount of disturbance usually obtained in the outer edge of the sample due to well friction in the tube. From the information obtained from the two series of borings a soil profile was prepared. This profile shows quite clearly the uplift and the basin which was filled by later deposits. The clay formations of the earlier period rise to above the river bed at a point about mid channel and from there rise further to form the east bluff bank. West of mid-channel the clay formation drops down and on the west bank is not found until an elevation of -192 MGL is reached. The borings indicate that all of the underlying materials are of sedementary deposit, the clays and sands occurring in distinct lenses.

Determination of Foundation Depths and Pier Types

Study of the cores obtained from the borings showed that aside from determining depths to which the piers should be carried to obtain a material capable of supporting the foundation load, consideration must also be given to the effects of scour and possible movement of the east bank. The layout being considered at the time and which was subsequently adopted for construction has two piers located in the channel of the river where a maximum amount of scour might be anticipated. The river bed at the location of the east pier was at elevation -72 and consisted of quite a coarse sand to elevation -107. Underlying this sand there was found a hard blue clay which extends down to elevation -150. At this elevation a fine gray packed sand was found down to elevation -197, when another layer of blue clay similar to that found above was encountered. From this information it can be seen that protection against possible erosion of the stream bed due to the obstruction of the waterway would be secured by sinking the pier deep into the top clay strata or into the sand below. With this reasoning it was decided to carry the pier into the sand and sink it to elevation -160. The boring at the location of the west channel pier showed a similar though not quite as favorable condition. Here the top layer of sand was found to be much deeper and the hard blue clay overlaying the grey packed sand not as deep as found at the site of the east pier. Here the river bed was at elevation -40, the sand varying from fine to coarse and extending down to elevation -153, where the hard blue clay was found. The clay at this point goes to elevation -179, where the grey packed sand was encountered. From this information it was decided that the west channel pier be sunk to elevation -180, which is in the grey packed sand.

In the case of the east bank piers consideration was given to bank movement and its possible effect on the stability of the piers located therein. Careful study of the soil profile indicated that the pier at the waters' edge (No. 2) which is to carry the same load as the two channel piers, be founded in the same stratum of grey packed sand as the two channel piers (3 and 4), and by being carried to such depth it would

be rendered stable against movement of the upper bank. The easterly pier (No. 1) or shore anchor pier, was first considered with a concrete pile foundation with bottom of footing at about elevation +20. However, it was finally decided to construct this pier without piling, landing at elevation -80 in the hard blue clay strata found at both piers 2, 3 and 4. This decision was based on the theory that more stability than that provided by a pile foundation is needed at this location. Also that a satisfactory foundation material is within economical reach.

The case of the two piers located in the west bank of the river (Piers 5 and 6) presented a somewhat different problem. We have here a bank that is not caving and on the opposite side from the main channel. Also, it is made up to a depth of over 200 feet of relatievly recent alluvial deposit. Taking the case of the pier near the water edge it was found from the borings that the top bank was made up of river silt and soft blue gumbo down to elevation -50, where a medium fine grey sand was found, this sand increasing in coarseness and extending down to elevation -192. Here again the hard blue clay found at the other pier locations was encountered. With a condition showing very little danger of scour, the pier being located well up into the river bank, it did not appear economically reasonable to sink this pier to an unusually great depth. From cores obtained from the borings it appeared that good foundation material could be found at elevation -110, which material is a coarse grey sand containing some gravel. Here it was decided that this pier be placed. The west anchor pier (No. 6) is located behind the levee and as previously stated, there is little or no fear of bank erosion or movement. Therefore, this pier has been founded on a pile foundation. The footing elevation is -0.70 and piling 50 feet in length extend into the sand below the silt and clay top bank.

At this point in our studies pier types were determined. For pier No. 1, the east anchor pier, a concrete clyinder type open caisson was adopted as it is felt that the circular shape will prove beneficial in the event of bank movement. For piers Nos. 2, 3, 4 and 5 a cellular type concrete caisson, rec-

tangular in shape and having 12 dredging wells, was used with the thought that this type of structure would provide the most ease in sinking as well as prove economical. As previously stated, Pier No. 6 was placed on a pile foundation.

The piers as finally planned produced foundation loads (gross vertical) of 8.7 tons per square foot at Pier No. 1, 13.7 tons per square foot at Pier No. 2, 13.8 tons per square foot at Pier No. 4, and 11.2 tons per square foot at Pier No. 5. These loads include the dead load of the pier, dead load of the superstructure and live load of the superstructure. To determine the adequacy of the foundation material on which it has been planned to found the caisson piers, undisturbed samples were used in making 36 consolidation tests and the characteristics thus found showed the material to be similar throughout in each stratum considered. The procedure used in making the compression test is that outlined in the paper prepared by Mr. F. Robeson of the Bureau of Public Roads, contained in "Public Roads," Volume 16, No. 12, 1936. Undisturbed samples were tested for moisture content in the field. Undisturbed samples of one cubic inch being cut out from the cores immediately upon their removal from the sampling tube. Moisture content was again checked in the laboratory by specific weight and specific gravity.

The method used for analyzing the various strata which will support the piers is as follows:

The soil stratification lends itself readily to consolidated analysis. The borings show the various strata fairly homogeneous throughout their depths. Also, drainage courses are provided for the consolidation of the clays. In computing the overburden loads, the weight of the soil was taken at an average of 100 pounds. No deduction was made for buoyancy in either of the soil overburden or the volume displaced by the pier structure. The weight of the water that was considered to be on the foundation was taken to the elevation of low water, 00 MGL. The pressure was considered as distributed uniformly over the entire area of the footing, using trapezoidal pressure distribution, i. e., the pressure increasing with increasing depth in the compressible stratum. The

pressures at both top and bottom surfaces are finite values, each greater than 0. It has been considered necessary to subdivide the footing into units of such size that the load on each is sufficiently small to be considered a point of concentration, i. e., the foundations have been divided into squares approximately 6′, and the average stress under the actual piers thereby determined, using the stresses and corresponding voids ratio from the consolidation courses. Total ultimate settlements have been computed by the formula:

$$\text{Settlement} = \frac{e1 - e2 \times d1}{1 \times e2}$$

Where e1 = average voids ratio prior to loading.
e2 = average voids ratio after loading.
d1 = the depth of the strata considered.

Time consolidation tests made on samples of the sand stratum on which piers 2, 3, 4 and 5 are founded show that between 90 and 100% consolidation occurs almost immediately. The plotted tests result in two straight lines, one vertical and one horizontal. The settlement, therefore, due to consolidations in these sand strata, is considered to occur with the application of load. The rate of consolidation in the clay strata has been calculated in accordance with the method outlined in the report of the Special Committee on Earths and Foundations of the American Society of Civil Engineers, Volume 59, No. 5, May, 1933, Proceedings.

Results of information obtained in this manner show no excessive settlements to be expected. Settlements after the expiration of 20 years for each of the piers being computed as follows:

Pier No. 1—¾ inch.
Pier No. 2—3¾ inch.
Pier No. 3—2 inch.
Pier No. 4—2⅜ inch.
Pier No. 5—1¼ inch.

Finishing of the bridge seats will provide for these settlements. This concludes the study of the foundations made prior to the completion of the plans.

Construction

Plans for the project were completed in the spring of 1937 and bids were received on May 26 of that year for both substructures and superstructures of the main bridge and approaches.

The Kansas City Bridge Company of Kansas City, Mo., was low bidder for the main bridge substructure, and the Uvalde Construction Company was low bidder for the approach substructure. These contractors moved on the job in August, and work was then started.

The first work to be done on the main river structure was the construction of mattresses at the site of piers 3 and 4 to protect the caissons from scour of the river bed during construction. These mats, measuring 250 feet by 450 feet, were of the conventional board type.

To go back a step, the contract for the main piers provides that the contractor devise his own methods for constructing the caisson piers, and in this instance the Kansas City Bridge Company chose to use the Sand Island Method which was used on the Mississippi River Bridge at New Orleans with apparently good results, although this site does not have the great difference between high and low water stages that occur at Baton Rouge.

This so-called Sand Island Method has been used for all of the river or caisson piers, piers 2, 3, 4 and 5, and though the sand island construction has varied, a steel shell being used for the channel piers (3 and 4) and steel sheet piling used for the piers located at the low water edge (2 and 5), the principle of the construction has been the same.

The sand islands consist of steel cylinders made up of steel plates and steel sheet piling set into the river bed to a depth sufficient to provide stability of the filling mentioned hereafter. In order to erect the sand island cylinders in the channel of the river and later carry on the pier construction, a dock structure of considerable size is necessary. The docks in this case consisted of timber piling driven completely around the cylinder location and framed to support the handling equipment necessary for the erection and lowering of the sand island shell, also to care for two revolving der-

ricks and steam plant with which to carry on the caisson and pier shaft construction.

At pier No. 4, the west channel pier, the dock consisted of 147 fir piles 108 feet long, having butt diameters 16″ to 20″ and tip diameters 9″ to 12″. Piles were driven to a penetration of approximately 20 feet, and the dock constructed with the top about thirty feet above low water. The sand island for this pier was 111 feet in diameter, 80 feet in height with its bottom at elevation -50. Filling material was obtained from the west river bank about 2,000 feet above the bridge site. This material was dredged with a hydraulic dredge discharging into barges which were towed to the pier site and material placed in the sand island with clam shell buckets. With the sand island filled above the water level approximately 15 feet, the contractor was ready to start construction of the concrete caisson.

At Pier No. 3, the same procedure was followed as at Pier No. 4. This pier is some larger however, thereby requiring a larger sand island and dock structure. Also, as this pier is located in a deeper portion of the channel, larger piling and steel cylinder of greater height were required. Piling 135 feet long were required to obtain penetration sufficient to provide stability and allow for some rise in the river.

At Piers No. 2 and 5 steel sheet piling were driven to retain the sand islands which were of lesser height than those for piers 3 and 4, the original ground line being at a much higher elevation. By using the steel sheet piling, dock structure was made much smaller as no provision needed to be provided for the equipment necessary to construct, lower, and later remove the sand island shell.

Actual construction of the caisson for Pier No. 4 was begun with the setting of the steel cutting edge on November 13, 1937. However ,this pier has not yet been completed due to difficulties encountered by the contractor during the high water of last spring. At this time the caisson for this pier has been sunk to elevation -164, and has 16 feet yet to be sunk before reaching its final position.

The sand island for Pier No. 3 was not completed until December 22, 1937, and at this time the contractor was faced

with the problem of whether or not it was safe to proceed with the construction of the caisson in the face of the approaching high water season. The contractor decided to proceed, however, and work on the caisson was begun as at Pier No. 4, with the setting of the steel cutting edge on December 23. Work on this pier continued through the winter and spring and although high water interfered with progress at various times, there were no serious mishaps. This pier was completed the latter part of September of this year.

Work was started on Piers 1 and 6 in the fall of 1937, and continued without any unusual difficulties until completion this summer. Pier No. 1 as previously stated, has a concrete cylinder type caisson. This caisson has a diameter of 47 feet, and has a 9-foot wall. Dredging to sink this pier was carried on in the dry until the caisson reached practically final depth. However, it was found necessary to partially fill the dredging well with water before the material under the sloping cutting edges could be removed to provide necessary support and stop further sinking.

Pier No. 6, having a pile foundation was constructed inside a steel sheet pile cofferdam. Upon completion of the cofferdam, two test piles were driven to a depth of 50 feet below the bottom of footing and test loads applied. The test loads were applied with hydraulic jacks in increments. The first increment of load was 25 tons and this load was increased by 5 tons until 75 tons had been reached. Increments were placed at six-hour intervals up to a load of 40 tons, at which time interval was increased to 12 hours. The final load was allowed to remain on the piles for a period of 48 hours. A total settlement of 15/30″ and 27/32″ was recorded under the 75-ton load. With the release of the loads a total net settlement of 7/32″ and 1/2″ were recorded on the piles. From the information obtained, pile lengths were determined. Twenty-nine reinforced concrete test piles were driven to determine pile lengths for the approach substructures. These piles were loaded to 80 and 100 tons and the information obtained in this manner formed the basis on which to calculate the final length of piling to be cast and driven.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Board of Direction, October 6, 1938.

The meeting was called to order by President Grehan with Stewart, Williamson, Hill present.

The reading of the minutes was dispensed with.

The following were selected by the Board to serve as the Nominating Committee:

HENRY J. MALOCHEE,
JOHN RIESS,
JOHN H. O'NEILL, *Chairman.*

The Secretary was directed to write to each Board Member who was absent for confirmation of the above selection.

A letter was read from James M. Todd concerning the election of an Honorary Member. President Grehan said that he would reply, calling Mr. Todd's attention to the ruling in the Constitution with regards to Honorary Members.

It was suggested that a committee be appointed at the next meeting to look into the possibility of forming sections in various portions of the state.

There being no further business, the meeting adjourned.

A. M. HILL, *Secretary-Treasurer.*

Minutes of the Regular Meeting of the Society, October 10, 1938.

The meeting was called to order by President Grehan with about 110 members and guests present. The reading of the minutes of the previous meeting was dispensed with.

The speaker of the evening was Mr. E. G. Grady, Plant Engineer of the Masonite Corporation of Laurel. His topic was "The Manufacture of Masonite and Allied Products." The process of manufacture from beginning to end was shown by means of slides each step being fully explained.

Numerous questions were asked concerning Masonite and its uses. Mr. Grady displayed a number of interesting samples of various forms.

A rising vote of thanks was tendered the speaker.

Mr. James M. Todd, Chairman of Arrangements for the Spring Meeting of A. S. M. E. to be held in New Orleans in February, spoke briefly of the plans thus far developed.

There being no further business the meeting adjourned.

A. M. HILL, *Secretary-Treasurer.*

Minutes of the Regular Meeting of the Society, November 14, 1938.

The meeting was called to order by President Grehan in the Hunt Room of the St. Charles Hotel. This was a joint meeting with the Society of American Institute of Chemical Engineers.

The minutes of the last meeting were read and approved.

The report of the Employment Committee was presented.

A brief address by Dean Robert was made on behalf of the Community Chest.

The announcement was made that on November 28 the Society would meet with the Society of American Military Engineers.

Chairman Rhodes of the House Committee announced that each day for luncheon there would be reserved an "engineer's table." He urged that members get together there whenever possible, and make this an institution in the Society.

The meeting was then turned over to Prof. C. S. Williamson, chairman of the Local Section, American Institute of Chemical Engineers.

The paper of the evening was entitled "Some Problems in Pilot Plant Work" and was presented by Francis McBryde Taylor, Assistant Professor of Chemical Engineering, Tulane University.

Questions and discussion followed the paper. Some additional points were discussed by Mr. Harold A. Levey.

The meeting then adjourned to the usual collation.

A. M. Hill, *Secretary-Treasurer.*

ACTIVITIES OF LOCAL SECTIONS

President,
W. H. RHODES

1st Vice-President,
A. J. NEGROTTO

2nd Vice-President,
N. E. LANT

Secretary-Treasurer,
J. A. McNIVEN

STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

Special Meetings at
call of President

The next meeting of the Louisiana Section, A. S. C. E., will be held December 16th, at 8 p. m., in the Hunt Room of the St. Charles Hotel, New Orleans.

At this time an address on "Slum Clearance and Low Rent Housing Projects in New Orleans" will be delivered by Mr. Alvin M. Fromherz, M. A. S. C. E., Consulting Engineer-Executive Director, Housing Authority of New Orleans. Questions relative to the address are invited by Mr. Fromherz.

Exhilirators, to be served before the meeting, will be prepared by Ole K. Olsen, member of the Section, a specialist in this field of endeavor. A collation will be provided after the meeting.

On November 5th the Student Chapter at Tulane University inspected the asphalt mattress works of the U. S. Engineers under direction of Captain G. T. Derby, C. E. After the inspection, dinner was served the group aboard a U. S. Engineer Department quarter boat. On December 5th twenty members of the Chapter inspected the repair shops of the Southern Pacific Railroad, in Algiers, under the direction of Mr. F. B. Elliot, Shop Foreman.

The Louisiana State University Student Chapter, consisting of a hundred per cent membership of the Junior and Senior Civil Engineering classes and a large representation from the sophomore class, was shown a three-reel motion picture on "The Manufacture of Wrought Iron Pipe" at their last meeting. This picture was secured through the efforts of Mr. N. E. Lant, Bridge Engineer of the Louisiana Highway Commission, who sponsored the meeting.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

DECEMBER, 1938

"PATRONIZE OUR ADVERTISERS"

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