

PROCEEDINGS
of the
LOUISIANA
ENGINEERING SOCIETY

VOL. XXV, 1939

PUBLISHED BI-MONTHLY
BY THE
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NEW ORLEANS

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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THE PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

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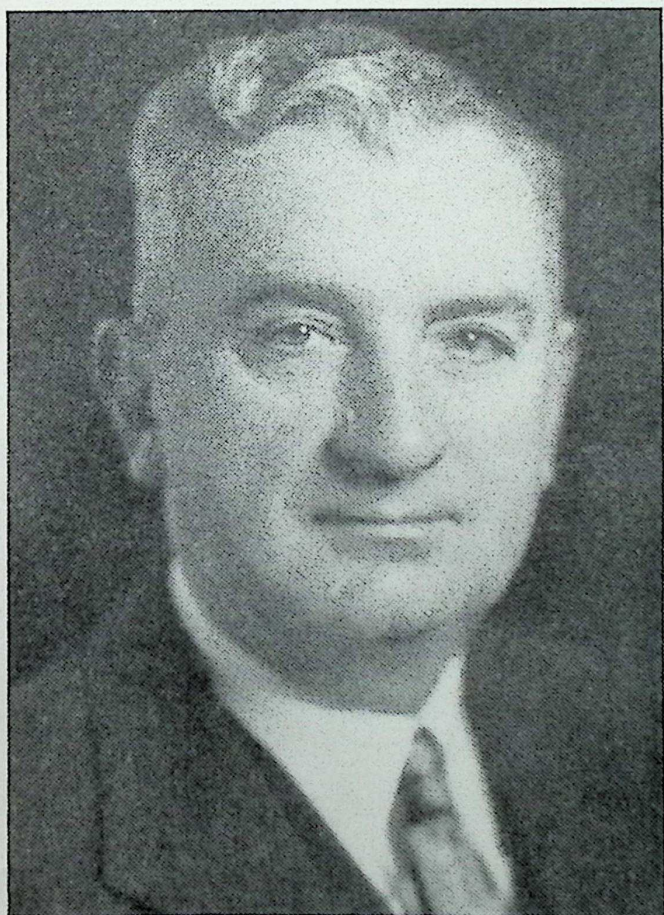
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The last name on each committee is the Junior member, who sits with the committee, but without vote.



WILLIAM H. RHODES

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. XXVI.

FEBRUARY, 1940

No. 1

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EDITORIAL NOTES AND COMMENT

Our New President. William H. Rhodes was born in Springfield, Mass., December 29th, 1886. There he attended grammar and high school. In 1906 he entered Worcester Polytechnic Institute at Worcester, Mass., where he graduated in 1910 with the degree of Bachelor of Science in Civil Engineering.

In the summer of 1910 he was appointed Junior Civil Engineer with the United States Bureau of Public Roads. This was almost at the beginning of the "good roads" movement

in the United States. In the East highway systems had been built but in the South and Mid-West such improvements were just beginning and it was one of the main duties of the engineers of the Bureau of Public Roads to visit communities with local engineers and officials and develop interest in the building of "good roads." This also involved design and construction of the proposed improvements. All of this gave excellent experience in planning County and State systems, design and construction of all types of bridges and all types of road surfaces. Much surveying and location was necessary.

From September, 1916 to May, 1919 he served as Captain of Engineers in the United States Army with seventeen months in France with the First Army. Upon return to United States he was appointed Senior Highway Engineer of the U. S. Bureau of Public Roads in charge of Federal Aid Road Construction in Louisiana.

From April, 1922 to November, 1924 as State Maintenance Engineer he organized the Maintenance Department under the newly formed Louisiana State Highway Commission. This involved the employing of necessary engineers and superintendents, as well as laborers, and the purchasing of all equipment and materials necessary to form and conduct this department.

From November, 1924 to June, 1927 he was employed by the Oklahoma Highway Commission as Maintenance Engineer to organize and direct their newly authorized Maintenance Department. The experience found there was substantially the same as in Louisiana, although Oklahoma did have considerable mileage of higher type pavements which Louisiana had lacked.

From 1927 to 1940 he has been with Shell Oil Company, Incorporated, New Orleans, in the Asphalt Sales Department in constant co-operation with Municipal and State Highway Engineers.

He has been a member of the Louisiana Engineering Society since 1927 and a member of the American Society of Civil Engineers since 1922. He was President of Local Section of American Society of Civil Engineers in 1938.

The Annual Meeting. Our fifth Annual Two-day Convention was indubitably a most successful affair. For the first time two technical sessions were in progress concurrently. Papers covering a wide subject range and extremely high quality were presented, offering material of very real value. The registration totaled four hundred and sixteen—a splendid showing.

Much praise is due our general Chairman, Dave Stewart, who with various other committees worked untiringly for three months previous to the meeting dates of January 12 and 13. Chairman Karl Kammer of Technical Papers, Arthur J. Naquin of Publicity and Ole K. Olsen of the Banquet Committee aided greatly in the successful meeting.

The banquet and dance was a gay and festive affair with not too much serious business, yet enough for a well-balanced program. Those who attended we know will come again. Those who could not come, we hope will be there next year.

The Baton Rouge Section Officers. At a recent meeting of the Baton Rouge Section the following officers were elected: President, Professor B. W. Pegues ;first vice-president, W. W. Tennant; second vice-president, N. E. Lant; secretary-treasurer, Charles A. Myers.

President Pegues is a Life Member of the Society and Head of the Civil Engineering School at Louisiana State University. All of the foregoing officers have been active in organizing the section and securing new members. Under such able guidance the Baton Rouge Section should increase in membership during an inevitably successful initial year.

President's Address. Our new President, William H. Rhodes, has a message for the membership in this issue. These ideas were presented at the Annual Meeting banquet. It is prefaced here, however, by an autobiographical sketch which, despite the modesty and general self-effacement characteristic of all engineers, we finally prevailed upon him to give us.

Mr. Toastmaster, Ladies and Gentlemen: I very greatly appreciate the honor of being President of the Louisiana En-

gineering Society and thank the members for their kindness in electing me. Having been on the Board of Direction for several years I fully realize the responsibility of maintaining the high standards already established. During the past several years the Society has grown, not only in membership but also in activities and interests. With the excellent Board of Direction selected for this year, I am confident that we can keep up with the pace set by their predecessors.

Last year a Chapter or Local Section of the Society was established in Baton Rouge. The establishment of that Section very evidently was a good move as already we have been able to secure many new members from that part of the State showing new interest. The Society should continue to expand as we now hope to establish local sections in other cities in the State such as Shreveport, Monroe, and Lake Charles. It is realized that these cities do not have at this time enough members in the Society to permit formation of new sections, but I believe that by well directed efforts on the part of all of us we can secure enough new members to form local sections there. Of course, the object of increasing our membership is to increase our influence and give us prestige so that we can more fully maintain the objects of the Louisiana Engineering Society, which are: "The professional improvement of its members, the encouragement of social intercourse among engineers and men of practical science, and the advancement of Engineering."

The first object, that is "the professional improvement of its members," can be partly obtained through our meetings, which are held monthly, or even more often should the occasion require it. At these meetings we have the opportunity to come together and listen to papers on engineering subjects with the further advantage of a discussion of the papers afterwards. This is the most active function of the Society. In the past, our Technical Papers Committee has had to make very strenuous efforts to secure papers from our members who for some reason seem not to care to read papers and tell the other engineers of their activities. I, personally, believe that nearly every member of the Society who is engaged in work involving

design, construction or operation of engineering projects has in his own knowledge many ideas that he could very successfully put into a paper which can be either long or brief, as he so wishes. I trust that the membership this year will help the Society and its members by assisting and participating more actively in these meetings. We have very excellent rooms in this hotel with a fairly good library, which are available to the members for meetings, conferences or reading and study. This library, its up-keep and housing, however, presents a problem that the Society will be confronted with during this year. The library is not very up-to-date, except for the section which contains the bound volumes of the current engineering periodicals. Our Library Committee will work out a plan for improvement and report to us later in the year.

Another object, as outlined in the Constitution of the Society, is the advancement of engineering. One of the ways of making such advancement is by securing for the engineering profession a more prominent standing in the community.

Louisiana is one of the very few States in the Union which do not have a professional engineering license law. Our only law is for the registration of the Civil Engineers and Surveyors. Many very careful plans in the past have been made and bills drawn for presentation to the State Legislature but for various reasons these bills have not been passed. I believe it is distinctly a function of this Engineering Society to poll its members again as to whether they want a professional engineering law and if they do, to assist in the preparation of such a bill, giving all possible support to help in its passage through the Legislature. Such a law would at least clarify the standards required for professional engineering in Louisiana.

I believe I have briefly stated what we have in mind for the year 1940 and know that the Board of Direction and myself sincerely request your active co-operation.

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

Abrahamson, Carl E. State Member. Age 40. Endorsed by C. A. Myers, N. E. Lant, E. L. Erickson. U. S. Army 1918, OF

Reisner Lecompte, 1919-20. General engineering, office and field work Louisiana Highway Department. Instrumentman Colfax, 1921. Road drafting 1921-29, Louisiana Highway Dept., Bridge Department; detailed and general drafting, 1929-date. Address: P. O. Box 1002, Baton Rouge, La.

Bartley, John C. Junior Member. Age 23. Endorsed by D. Derickson, J. M. Robert, D. H. Godat. Graduate Tulane, B. E. in C. E. 1936. Gulf Research and Development Corporation, Pittsburgh, surveyor 1936-37. City of New Orleans Assistant Engineer, City Engineer's Office 1937 to date. Address: 2303 Joseph Street, New Orleans.

Bryan, William P. State Member. Age 31. Endorsed by C. A. Myers, S. C. Magaw, H. B. Henderlite. Graduate Louisiana State University, B. S. in Petrol. Eng. 1929. With Louisiana Highway Commission since 1930 as junior draftsman, senior draftsman; at present squad leader. Address: Coolidge Street, R. F. D. No. 4, Baton Rouge, La.

Cami, Roy M. State Junior Member. Age 22. Endorsed by D. Derickson, J. M. Robert, F. H. Fox. June 9, 1938, began work for U. S. Bureau of Agricultural, Eng. in drainage field as assistant engineer aide. June 1, 1939, promoted to junior engineer. Now transferred to soil conservation service. Address: C. C. C. Camp, Thibodaux, La.

Castille, William A. Member. Age 28. Endorsed by B. W. Pegues, L. J. Lassalle, F. F. Pillet. Graduate C. E. from Louisiana State University 1936. Insp. of Const., Humble Oil Co. 1 year, 1936-37. C. E., Humble, 1938. November, 1938, to present, Dist. engineer, Humble, for So. La. Address: 2307 American Bank Bldg., New Orleans.

Catchings, N. S. State Member. Age 39. Endorsed by C. A. Myers, H. B. Henderlite, C. A. Ives, Jr. Graduate Mississippi A. & M., 1924, C. E. With Louisiana Highway Commission 12 years. U. S. Government 2½ years. Address: P. O. Box 532, Baton Rouge, La.

Cobb, Angus B. State Member. Age 35. Endorsed by H. B. Henderlite, C. A. Myers, J. P. McCullough. 1½ years draftsman, Tennessee Highway Department. 1½ years senior draftsman Louisiana Highway Commission, 2 years instrumentman Louisiana Highway Commission, 1 year resident engineer,

Louisiana Highway Commission, 1 year local engineer Iberia Parish, 2 years R./W. and const. Pure Oil Co., 2 years Dr. engineering, Bureau Agr. Eng., Abbeville, La., 3½ years senior draftsman Louisiana Highway Commission. Address: 354 Bedford Drive, Baton Rouge, La.

Flanakin, Hubert A. State Member. Age 34. Endorsed by L. J. Lassalle, F. H. Fenn, M. J. Cramer. May, 1936, to date, financial manager and assistant office engineer in charge S. W. H. P. S., Louisiana Highway Commission. February, 1931, to May 1936, Bridge Department Louisiana Highway Commission. June, 1929, to February, 1931, American Bridge Company. January, 1929, to June, 1929, La. Oil Ref. Corp., Shreveport. June, 1927, to January, 1929, Webster Parish Highway Department, Minden, La. Address: 602 East Boulevard, Baton Rouge, La.

Guedry, W. S. State Member. Age 47. Endorsed by N. E. Lant, C. A. Myers, W. L. Thompson. May, 1936, to date, inventory manager, S. W. H. P. S. April, 1929, to May, 1936, resident engineer Louisiana Highway Commission on concrete highways. June, 1926, to April, 1929, reconnaissance engineer on gas lines. Reports on gas line Monroe to St. Louis, Monroe to Atlanta, etc. Prior to 1926, resident engineer and district engineer Louisiana Highway Commission. Address: 315 St. Louis Street, Baton Rouge, La.

Kiernan, Bernard L., Sr. Member. Endorsed by L. E. Flotte, L. L. Newman, A. M. Hill. Age 46. 1923-31, sales engineer and designer of refrigeration and cold storage plants. O. E. Lewis Company, Inc., 9 years. 1931 to 1932, chief engineer Edgewater Gulf Hotel. 1932 to 1936, assistant engineer National Brewing Company. 1933 to 1936, Chemical engineer Standard Brewing Company; 1936 to date, chemical engineer, Jackson Brewing Company. Address: 514 So. Scott Street, New Orleans.

Kirby, O. G. State Member. Age 38. Endorsed by C. A. Myers, N. E. Lant, C. A. Ives, Jr. 1922 to 1926, Louisiana Highway Commission, rodman and instrumentman. 1927 to 1928, with J. M. Fourmy as resident engineer on highway construction and assistant city engineer on city paving. 1928 to 1933, with Louisiana Highway Commission as resident engineer and

district engineer, Robinson & Young, contractors. Engineer and estimator, 1936 to 1937, with Louisiana Highway Commission as assistant traffic manager H. P. S. 1937 to date with Robinson & Young, contractors, engineer and estimator. Address: 1925 Wisteria Street, New Orleans.

Muse, Leo J. State Member. Age 37. Endorsed by N. E. Lant, B. W. Pegues, F. F. Pillet. B. S., M. S., Louisiana State University; M. S. in C. E. at University of Michigan. Draftsman for A. G. Seigried, January, 1924, to May, 1926. Construction engineer grounds development, Bolton High School to January, 1927. Subdivision development, construction roads, water supply, etc., to 1929. Engineer, Gas Dept. Baton Rouge Electric Company, 1930 to 1932. Office engineer, City Engineer's Office, Baton Rouge, 1932 to 1933. Instructor, C. E., at Louisiana State University, 1933 to 1937. Assistant professor, 1937 to date. Address: University, La.

Postell, W. D. State Member. Age 41. Endorsed by H. B. Henderlite, N. E. Lant, R. B. Richardson. 1921 to 1925, inspector, Jr. Eng. U. S. War Dept. Corps Engs. 1926 to 1927, resident engineer Louisiana Highway Commission. 1928 to 1936, Assistant Federal Aid Eng., Louisiana Highway Commission. 1937 to date, assistant office engineer, Louisiana Highway Commission. Louisiana State University, 3½ years in C. E. course. Address: 631 St. Anthony Street, Baton Rouge, La.

Smith, S. C. State Member. Age 41. Endorsed by C. A. Myers, N. E. Lant, E. L. Erickson. General contracting from 1925 to 1929. Resident engineer Louisiana Highway Commission 1929 to date on various bridge and road projects. Address: New Roads, La.

Swick, E. H. State Member. Age 30. Endorsed by M. J. Cramer, N. E. Lant, C. A. Myers. Graduate University of Maryland, B. S. in C. E. 1931. Coast Geodetic Survey in sub-professional and professional grades. Employed by Bureau of Public Roads as junior highway assistant. Highway and associate highway Eng. Econ., 1935 to date. Address: 341 East Boulevard, Baton Rouge, La.

Thomas, Ira L., Jr. State Member. Age 40. Endorsed by N. E. Lant, C. A. Ives, Jr., H. B. Henderlite. Resident engineer Louisiana Highway Commission, 1924 to 1934. Chief of party,

Board of State Engineers, 1934 to 1936. Office manager, S. W. H. P. S. of Louisiana Highway Commission, September, 1936 to present. Address: Care S. W. H. P. S., Louisiana Highway Commission, Baton Rouge, La.

Tunner, George H. Member. Age 35. Endorsed by C. S. Williamson, H. A. Levey, H. P. Newton. 1926 to 1929, development engineer and guarantee engineer on Diesel engines, Bethlehem Steel Company. 1929 to 1932, engineer, development department iron working methods, Western Electric Company. Safety Engineer and boiler inspector with the Travellers Insurance Company, 1924 to 1938. March, 1938 to May, 1939, resident engineer in charge engineering and inspection division office at Wichita, Kans. June, 1939 to date, resident engineer in charge local engineering and inspection division office. Address, 2830 Palmer Avenue, New Orleans, La.

Villa, A. P. State Member. Age 35. Endorsed by C. A. Ives, Jr., C. A. Myers, N. E. Lant. Graduate State College, Angola, Ind., 1931, with B. S. in C. E. Employed from July, 1933, to November, 1935, by the Emergency Conservation Work as engineering foreman and acting camp superintendent. January, 1936 to August, 1936, assistant instrumentman by Louisiana Highway Commission. August, 1936, to present, as chief coding clerk and assistant inventory analyst by the Highway Planning Survey, Louisiana Highway Commission. Address: 228 N. 11th Street, Baton Rouge, La.

Student Engineer Members (Joining in October and November, 1939): J. L. Bell, R. E. Bell, L. I. Breffelh, H. J. Bultman, C. Bittenbring, E. P. Buquet, W. R. Burk, Jr., S. S. Carnegie, R. D. Cosgrove, H. L. Davis, J. T. Dwyer, L. P. Fadrique, R. B. Fell, C. L. Fisher, A. D. Gomez, W. R. Gulley, E. R. Gurtler, J. E. Harvey, R. A. Herrod, E. Hogg, L. Klein, D. M. Korn, I. M. Lais, R. H. Lister, N. H. McLaurin, P. Mitchell, E. L. Murphy, S. C. Murphy, F. O'Connor, R. J. Ory, A. C. Porter, J. E. Pottharst, R. R. Prechter, T. J. Rennie, M. P. Snyder, E. J. Soniat, Wm. Stanke, Jr., A. Smith, Jr., W. F. Tompkins, W. J. Verlander, I. C. Weidig, C. O. Weillbaecher, W. A. Wood, E. Arnoult, Mayer Mayer, Jr., Hyman Samuelson, A. A. Balcom, N. J. Landry.

PAPERS AND DISCUSSIONS

THE WAX LAKE OUTLET AND THE CHARENTON DRAINAGE AND NAVIGATION CANAL *

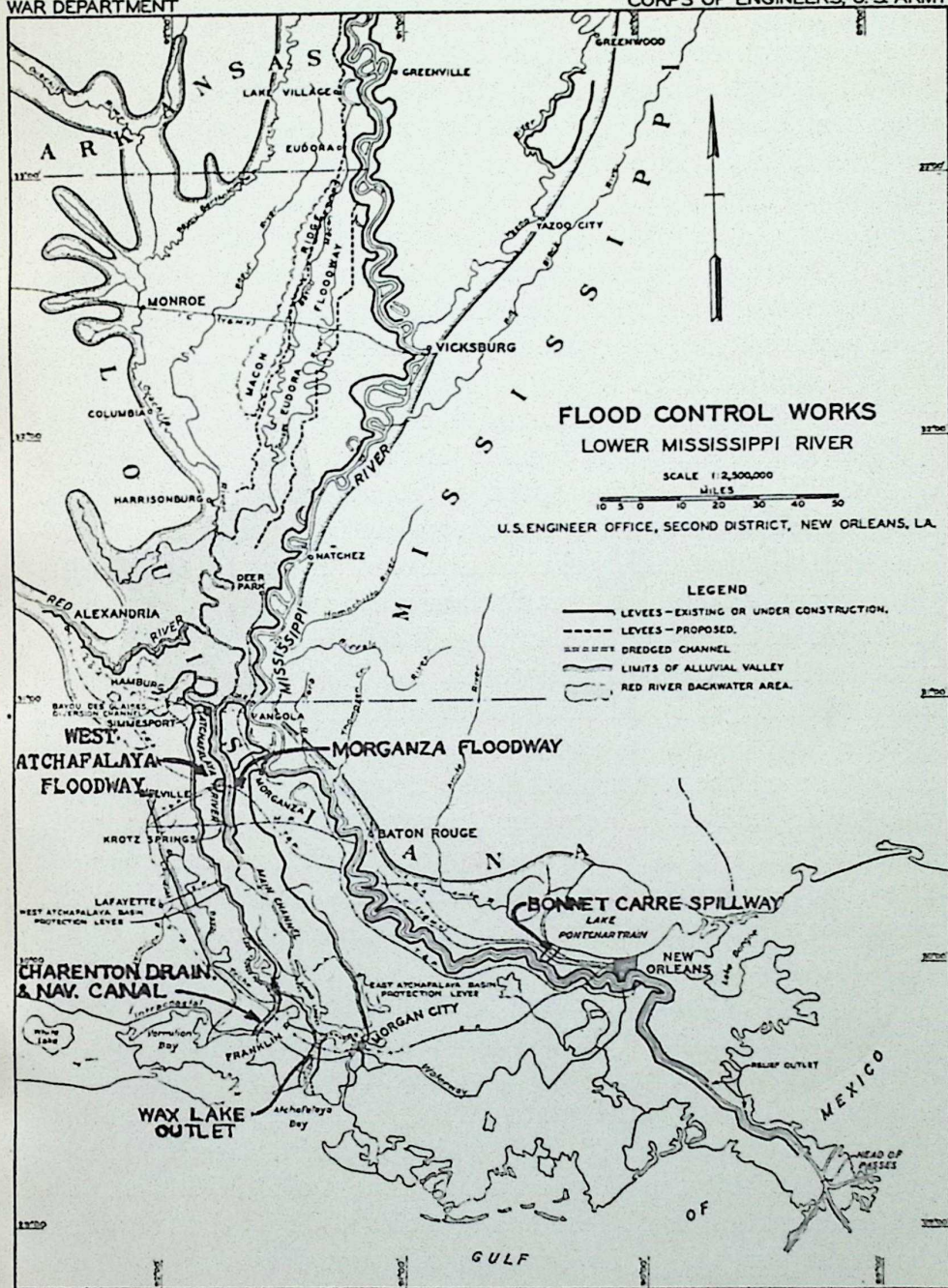
WILLIAM F. TOMPKINS,
Lieutenant Colonel, Corps of Engineers.

I am very glad to have the opportunity to present to the Louisiana Engineering Society a paper on the Wax Lake Outlet and the Charenton Drainage and Navigation Canal because I believe that you will find these projects interesting, not only on account of their unusual nature, but also because of the fact that they are located just a few miles west of Morgan City, Louisiana, which is only 90 miles from New Orleans by road.

As all of you probably know, the Flood Control Act of May 15, 1928, provided for a flood much greater than that of 1927, which was perhaps the greatest flood of record. This Act approved the engineering plans proposed by the Chief of Engineers to provide for a flood of 3,000,000 c. f. s. at the latitude of Old River. Of this 3,000,000 c. f. s., 1,500,000 c. f. s. were to be carried in the main river as far south as the Bonnet Carre Spillway, and the remaining 1,500,000 c. f. s. were to be carried in the Atchafalaya Basin Floodways to be provided by construction of the East and West Atchafalaya Basin Protection Levees. The West Protection Levee was to extend down to the vicinity of Calumet, which the East Protection Levee was to pass east of the terminate about five miles below Lake Palourde. Under this plan, the flood waters in the Atchafalaya Basin during extreme floods, which could not escape to the Gulf of Mexico through Berwick Bay and the lower Atchafalaya River, would pass over the high ground of Bayou Teche ridge, Morgan City being protected by a ring levee.

The Act approved June 15, 1936, commonly referred to as the "Overton Act," considerably modified the plans for the Atchafalaya Basin. The Morganza Floodway was substituted

* Delivered before the Annual Meeting of the Louisiana Engineering Society on January 13, 1940, by



for the East Atchafalaya Floodway. The East and West Atchafalaya Basin Protection Levees were extended southward through the latitude of Morgan City, and the construction of an additional outlet to the Gulf of Mexico west of Berwick was authorized. This outlet is to have a sufficient capacity to discharge to the Gulf of Mexico that portion of the superflood flow which, under the plan previously approved, was to pass over the high ground in the vicinity of Morgan City. Under this revised plan, it became possible to protect the cultivable lands along the Teche and Boeuf ridges and the vital transcontinental routes of communication at the latitude of Morgan City.

Detailed studies were made prior to the selection of the site for this additional outlet west of Berwick. In addition to the site which was finally adopted, in the vicinity of Wax Lake, from which it derives its name, two other possible locations—one near Baldwin and one near Franklin—were considered. The advantage of the routes further west was a slight lowering of stages in the lower Atchafalaya Basin because the locations were further upstream. However, the Wax Lake site was the more advantageous, all things considered. The total estimated construction cost at Wax Lake was considerably cheaper than for either of the other two sites; it required less excavation and fewer bridges; it traversed less cultivable land along the Teche ridge; and involved less opposition from local interests. The discovery of the Bayou Grue oil field near the Baldwin site made very doubtful the acquisition of the right of way in that vicinity even at a high cost.

A dredged channel connecting Six Mile Lake with Atchafalaya Bay has a capacity of 275,000 c. f. s. under superflood conditions. It has a bottom width of 300 feet from Six Mile Lake to a point about $\frac{1}{2}$ mile south of Bayou Teche, where the bottom width widens to 400 feet, which is maintained from that point to Atchafalaya Bay, an arm of the Gulf of Mexico. The bottom elevation is 45 feet below mean Gulf level throughout the entire length of the channel. Except for silty materials near the surface, such as silt loam and silty clay loam, the excavated material is predominantly clay. The spoil from the dredged channel is utilized to construct side levees tying into

the West Atchafalaya Basin Protection Levee on both sides of the outlet and extending from the vicinity of Six Mile Lake across Bayou Teche southward to the Louisiana-Texas Intracoastal Waterway. Gaps will be left for navigation openings at the Intracoastal Canal, and south of the canal, other gaps will be provided in the spoil banks for the more important bayou crossings. The distance between the guide levees and spoil banks varies from about 2,000 feet at the Teche ridge to about 10,000 feet opposite Wax Lake. The minimum grade of the side levees is approximately 2 feet above the computed flow line, though in the vicinity of Bayou Teche, where the dredged channel passed through the high ground of the Bayou Teche ridge and more volume is required for spoil disposal, a maximum grade of approximately 4 feet above the minimum was specified. Definite limits were placed on the spoil disposal areas so as to retain as much overbank section as possible for flow. The outlet will be spanned by two bridges, one for U. S. Highway 90, the Old Spanish Trail, and the other for the Southern Pacific Railroad.

The first work on Wax Lake Outlet, subsequent to the securing of the approval of plans and the acquisition of the necessary rights of way, involved the dredging of the west half of the channel from Six Mile Lake to Station 610+00, about two-thirds of the way through Wax Lake. The spoil from this excavation was used in constructing the west side levee. The work was divided into three items: Item A—extending from Six Mile Lake to Bayou Teche; Item B—from Bayou Teche to the Intracoastal Canal; and Item C—from the Intracoastal Canal to Station 610+00. The work was advertised and bids were opened October 1, 1937. The McWilliams Dredging Company, the low bidder, was awarded the contract. The total amount of yardage involved in the contract was 24,262,317 cubic yards. The unit price was 7.7 cents per cubic yard. The excavation of the east half of the channel over the same limits was advertised September 10, 1938. This involved 18,780,103 cubic yards, the spoil being used to construct the east side levee. The McWilliams Dredging Company, the low bidder for this work also, was awarded the contract, the unit price being

7.14 cents per cubic yard. Both of these contracts have now been completed.

The McWilliams Dredging Company sublet Item A, the upper item, to the Sternberg Dredging Company, Item C, the lower item, to the United Dredging Company, and constructed Item B with its own plant. The Sternberg Dredging Company employed the dredges Grand Lake, Duplex, and Conical for channel excavation on Item A. The dredge Grand Lake, a hydraulic cutterhead with an 18-inch discharge, is electrically operated by a 60-cycle, 1000 horse-power motor, developing 450 revolutions per minute. It has its own power generating unit. The dredge Duplex, likewise a hydraulic cutterhead, has a discharge of 25 inches and is Diesel electrically operated. Its main engines have a total of 3500 horsepower. The clamshell dredge Conical, a departure from usual construction methods, derives its name from the large truncated cone which supports the boom and counterweight. The main engine is a 1000 horse-power Diesel engine. The dredge has an exceptionally long boom, 240 feet long, carrying a bucket of 6-yard capacity.

The United Dredging Company employed the dredges Burlington and Stockton on Item C. The Burlington is a steam-operated hydraulic cutterhead dredge. Its main turbine type engine, which develops 2500 horsepower at 4,000 revolutions per minute, was manufactured by the Ford Motor Car Company, and was originally intended for use in an American destroyer during the World War. This dredge has a discharge of 24 inches, suction 30 inches, and a ladder 78 feet long. The clamshell dredge Stockton has a 100-foot boom and a $3\frac{1}{2}$ cubic yard bucket.

The McWilliams Dredging Company employed at various times the dredges G. A. McWilliams, Sabine, Natchez, Texas, and Gulfport. The hydraulic cutterhead dredge G. A. McWilliams is a very large dredge, having a suction of 34 inches, and a discharge of 28 inches. This dredge is operated by a steam turbine developing 3,500 brake horsepower at 3,600 revolutions per minute, and is mounted on a 164-foot barge, 45 feet wide, and 12 feet deep. It has a ladder 100 feet long and is able to dredge 70 feet in depth. The Sabine is a steam-operated hydraulic cutterhead dredge of 20-inch discharge and 24-inch

suction, powered by an Elliott steam turbine engine of 1,500 horsepower. The Natchez, also a hydraulic cutterhead dredge, has a discharge of 20 inches, its suction being 22. It has a 1,000 horsepower Diesel engine. The Texas is a steam-operated clamshell dredge, with a steel hull 135 feet long, a boom length of 175 feet, and a 5½-yard California type bucket. The hydraulic cutterhead dredge Gulfport is Diesel operated, having an 800 horsepower engine. It has a steel hull 134 feet long, and 30 feet wide. Her ladder length is 75 feet, the suction is 22 inches in diameter, and the discharge 20 inches.

A variety of small plant was used in constructing the retaining dikes to confine the spoil. The material for these retaining dikes was taken from continuous ditches, landside of the side levees, which provided for drainage intercepted by these levees.

Bids for the excavation of the remainder of the channel required ;namely, for the portion from Station 610 to Atchafalaya Bay, were opened on January 9, 1940. The low bidder was Shell Producers Company, the unit price being 4.93 cents per cubic yard. This work, which was divided into three items, totals 13,500,000 cubic yards. One of the items, involving 1,100,000 cubic yards, is to provide a navigation crossover for the Intracoastal Waterway.

An interesting feature of the Wax Lake Outlet was the provision for navigation on the Intracoastal Canal across the outlet during high stages. While mean velocities in the outlet channel at the Intracoastal Canal will have a yearly maximum of one foot per second, the 5-year maximum will be 5 feet per second, and the maximum for the superflood, which is estimated to occur about once every 260 years, will be 10.5 feet per second. Two cuts are to be made, the upper cut for traffic going west, and the lower cut for traffic going east on the Intracoastal Canal. Each cut will be 100 feet wide on the bottom, which will be at an elevation of —15 M.G.L. Mooring basins are provided at each end. These cuts will permit tows to be headed into current and properly controlled when making the crossings during times when navigation directly across the canal perpendicular to the direction of flow would be hazardous or impracticable. The mooring basins will permit long tows

to be double-tripped across the outlet when the current is very swift. This plan for the navigation crossing of the outlet was recommended by the District Engineer of the First New Orleans District and the Division Engineer, Gulf of Mexico Division, after consultation by them with operators of towboats using the Intracoastal Waterway.

The total excavated material of the completed project will approximate 56,500,000 cubic yards; the total length approximates 15.7 miles; and the designed capacity at superflood stages 275,000 c. f. s.

The Wax Lake Outlet highway bridge will consist of three fixed steel truss spans, the central span being 511 feet in length and the two flanking spans each being 350 feet in length, a 40-foot reinforced concrete deck girder approach span at each end, and sections of earth approach embankment with roadway pavement thereon from beyond the side levees. The steel spans will be supported on deep reinforced concrete caisson piers and concrete abutments carried on untreated timber piling. The actual length of timber piling will be determined by driving and loading test piles as a part of the construction contract. For estimating purposes, the piles were assumed to be 65 feet in length. The bank ends of the reinforced concrete deck girder approach spans will be carried on precast reinforced concrete pile bents. For estimating purposes, the precast concrete piles were assumed to be 55 feet in length. The caisson piers will be sunk to an elevation of approximately 150 feet below mean Gulf level, where they will be founded in a compacted clay formation, and the bases of the pile supported abutments will be approximately 10 feet below mean Gulf level. The caissons will be cylindrical in section with an outside diameter of 38 feet for a distance of 40 feet above the cutting edge; above that elevation, they are lenticular in section with a long diameter of 36 feet 8 inches and a short diameter of 28 feet; they will be provided with a central circular dredging well 22 feet in diameter. The caissons will be sealed with 30 feet of concrete.

The steel spans and the reinforced concrete deck girder spans will be provided with a reinforced concrete roadway 24 feet in clear width for vehicular traffic and two sidewalks,

each $2\frac{1}{2}$ feet wide, for pedestrians. The pavement on the earth approaches will be 20 feet in clear width. The superstructure and substructure were designed by Mr. N. E. Lant, Bridge Engineer of the Louisiana Highway Commission, in accordance with the Louisiana Highway Commission specifications for highway bridges providing for H-15 loading. Silicon steel will be used in all main load carrying members of the steel spans to reduce the dead weight. The elevation of low steel will be 14.5 feet above mean Gulf level.

The highway alignment will be relocated so that the new bridge can be constructed to the north side of the existing alignment, thereby avoiding interruption to highway traffic.

The bridge will be constructed under contract let by the Louisiana Highway Commission, subject to reimbursement by the United States of actual cost. Bids were opened November 1, 1939, and a contract for the entire work has been entered into with the low bidder, the Missouri Valley Bridge and Iron Company. The total cost will approximate \$600,000.00.

The Wax Lake Outlet railroad bridge will consist of three 400-foot, single track, fixed steel truss spans with a 70-foot steel, deck girder approach span at each end and sections of earth approach embankments with ballasted roadway thereon from beyond the side levees. The steel truss spans will be supported on deep reinforced concrete caisson piers and the bank ends of the approach girder spans will be supported on concrete abutments carried on untreated timber piling. The lengths of the timber piling will be determined by driving and loading test piles as a part of the construction contract. The caissons under the central steel span will be sunk to an elevation of approximately 150 feet below mean Gulf level, where they will be founded in a compact clay formation; the caissons supporting the bank ends of the flanking spans will be sunk to an elevation of approximately 90 feet below mean Gulf level. The caissons will be oblong in section having a long overall dimension of 57 feet and a width of 31 feet; the ends will be semi-circular to a radius of $15\frac{1}{2}$ feet. They will be equipped with three dredging wells, the center well being approximately 10 x 19 feet in section and the two end wells semi-circular with a $9\frac{1}{2}$ -foot radius. The outside walls of the caissons will be

5½ feet in thickness and the interior walls between the dredge wells will be 5 feet in thickness. The deeper caissons will be capped at an elevation of 15 feet below mean Gulf level and the other caissons will be capped at elevation plus 0.5; short shafts will be constructed above the caps of the caissons to carry the span bearings.

The steel spans will be provided with an open, creosoted timber deck, with new 112-pound rail for the main tracks and 90-pound relayer rail for inner guard rails. The structure will be designed in accordance with the specifications of the American Railway Engineering Association for Cooper's E-60 live train loading. Silicon steel will be used in all main load carrying truss members to reduce the dead weight. The elevations of low steel of the structure will be 14.5 feet above mean Gulf level. Base of rail on the structure will be at 20.5 feet above mean Gulf level, which is about 11½ feet above the railroad's present base of rail. The transition in grade will be accomplished in the earth approaches to the bridge, which will be constructed on a .3 of 1 per cent ascending grade.

The new bridge will be located to the north of the existing railroad and highway alignments so that construction of the bridge and its approaches can be carried to completion without interruption of railroad traffic. The centerline of the railroad bridge will be parallel to and 150 feet southward of the centerline of the highway bridge.

The bridge will be constructed under contracts let by the Texas and New Orleans Railroad Company, subject to reimbursement by the United States of actual cost. Modjeski and Masters and the J. F. Coleman Engineering Company are the Consulting Engineers for the railroad company. Plans and specifications are practically completed and the work will be advertised in the near future.

The construction of the West Atchafalaya Basin Protection Levee resulted in interrupting drainage which formerly flowed generally in a southeast direction towards the Atchafalaya River and Grand Lake. The blocking of Bayou Teche, which will result from the creation of the Wax Lake Outlet, required that arrangements be made for navigation using that stream. Both drainage and navigation are to be provided for by the

Charenton Drainage and Navigation Canal. Its location is shown on the vicinity map. The canal follows the borrow pit of the West Atchafalaya Basin Protection Levee from Lake Fausse Pointe to the vicinity of Charenton Beach, where it cuts across the Teche ridge to Charenton. It then follows the Bayou Teche, which is enlarged, to the vicinity of Baldwin, where it cuts across to West Cote Blanche Bay, an arm of the Gulf of Mexico. The channel from Lake Fausse Pointe to West Cote Blanche Bay will provide for a flow of 11,000 c. f. s., sufficient capacity to take care of the accumulated intercepted drainage west of the West Atchafalaya Basin Protection Levee from the Mansura Hills to the Wax Lake Outlet. The channel has a bottom width of 150 feet. The bottom elevation is 15 feet below mean Gulf level. The material, except near the surface, is predominantly clay. The spoil from the dredged channel is disposed of in the most economical manner. Low levees have been constructed from the material obtained from drainage ditches along the outside edges of both sides of the right of way and these levees will also serve as retaining dikes to confine the spoil dredged from the channel.

The first work on this canal was the excavation of that section of the canal from Lake Fausse Pointe to Baldwin. It was advertised in two items; Item A, covering the upper part of the work, and Item B, the enlargement of Bayou Teche. Bids were opened September 19, 1938. The McWilliams Dredging Company, low bidder, was awarded the contract; the unit price was 4.93 cents per cubic yard; the total amount of yardage involved in the contract was 2,442,706 cubic yards. This contract has been completed. The portion of the work below Bayou Teche was advertised in two items on October 22, 1938. The McWilliams Dredging Company was also the low bidder on this work and was awarded the contract; the unit price was 7.98 cents per cubic yard; the yardage involved was 4,588,565 cubic yards. This contract is practically completed.

The McWilliams Dredging Company accomplished the work north of the Teche and in the Teche with its own plant, but sublet Items C and D, the work below the Teche, to the Sternberg Dredging Company and Jahneke Service, Inc. Aside from the minor items of plant used in construction of the retaining

dikes and side ditches, the McWilliams Dredging Company employed the hydraulic dredge Gulfport on Item A and the clamshell dredge Alabama on Item B. The Alabama is a steam-operated clamshell dredge having a 200-foot boom and a 5½-yard bucket of the California type. This dredge is mounted on a steel hull 140 x 65 x 9, and has a draft under normal working conditions of 7½ feet. The Gulfport, which worked on the Wax Lake Outlet, has been already described to you.

The Sternberg Dredging Company employed the clamshell dredge Conical. The Conical was also previously described during the discussion of Wax Lake. Jahneke Service employed the hydraulic cutterhead dredges Pontchartrain and Tchefuncta. The Pontchartrain, which is powered by a steam engine of 750 horsepower, has a ladder 57 feet long. Its suction is 20 inches, and its discharge 18 inches. The dredge Tchefuncta is powered by an 880 horsepower Diesel engine. The Tchefuncta has a ladder 79 feet in length, while the suction and discharge are 22 and 20 inches respectively.

The total length of channel is 15.6 miles, the total yardage to be excavated, 7,250,000 cubic yards, and the design capacity 11,000 c. f. s.

The bridge to carry U. S. Highway, Route No. 90, over the Charenton Drainage and Navigation Canal near Baldwin, Louisiana, is a high level bridge to avoid the use of a drawspan on this important highway. It will consist of a 300-foot fixed steel truss span located directly over the canal channel, flanked at each end by 1059.5 lineal feet of reinforced concrete deck girder spans and sections of earth approach embankments with roadway pavement thereon beyond the ends of the concrete deck girder approach structures. The central steel span will be supported on reinforced concrete piers carried on untreated timber piling and the reinforced concrete deck girders, except for the two end spans whose shore ends will be carried on precast reinforced concrete pile bents, will be supported on reinforced concrete bents carried on untreated timber piling. The base of the piers supporting the main span will be at an elevation of 25 feet below mean Gulf level while the bases of the footings of the bents supporting the reinforced concrete deck girders will be at an elevation of 1 foot below mean Gulf level.

The actual length of the piling to be used under the piers and bents will be determined by driving and loading test piles as a part of the construction contract. For estimating purposes, the length of the timber piles was assumed to be 60 feet. The precast concrete piles were assumed to be 70 feet in length.

The steel span and the reinforced concrete girder spans will provide a roadway 24 feet in clear width for vehicular traffic and two sidewalks, each 2½ feet wide, for pedestrians. The pavement on the earth approach embankments will be 20 feet in clear width. The bridge was designed by Mr. N. E. Lant, Bridge Engineer of the Louisiana Highway Commission, in accordance with the Louisiana Highway Commission specifications for highway bridges providing for H-15 loading. Low steel elevation of the channel span is 55 feet above mean Gulf level to comply with the vertical navigation clearance established by the Chief of Engineers. The horizontal navigable clearance provided by the structure will be in excess of the full bottom width of the channel. The bridge and its approaches are to be constructed with a maximum 4 per cent grade; a 1600-foot vertical curve will be provided symmetrical about the mid-point of the 300-foot channel span.

The highway alignment will be relocated to the south of the existing alignment for a short distance on each side of the canal and the new bridge will be constructed in the relocated alignment without interruption to highway traffic.

The bridge will be constructed under contract let by the Louisiana Highway Commission, subject to reimbursement by the United States of actual cost. Bids were opened October 25, 1939, and a contract for the entire work has been entered into with the Austin Bridge Company, the low bidder. The total cost will approximate \$475,000.00.

The bridge to carry the tracks of the Texas and New Orleans Railroad Company over the Charenton Drainage and Navigation Canal near Baldwin, Louisiana, will consist of a center-bearing double track, steel truss swing span, 204 feet in length, flanked by a 65-foot deck plate girder span on the west approach and an 81-foot deck plate girder span on the east approach. The piers and abutments will be constructed of reinforced concrete and carried on untreated timber piling.

The lengths of these piling will be determined by driving and loading test piles. The bases of the pivot and rest piers will be at an elevation of 26 feet below mean Gulf level and the bases of the abutments will be at an elevation of 20 feet below mean Gulf level. The bases of the pivot and rest piers will be encased in continuous diaphragms of interlocking steel sheet piling extending down to an elevation of 43 feet below mean Gulf level as a precautionary measure against possible future scour in the channel. The pivot pier shaft will be cylindrical, 38 feet in outside diameter, with the outside wall 4 feet in thickness; the shaft will be hollow except for two concrete web walls which intersect in the center of the pier to form a column support for the center bearing of the swing span; one web wall is parallel and coincident with longitudinal center-line of the span when closed and the other web wall is perpendicular to the former. The pivot pier will be capped with a reinforced concrete slab 5 feet thick. The caps of the pivot and rest piers will be provided with embedded grillages of steel I-beams to receive the side and end wedge bearings, the end latch mechanisms and the bearings of the deck plate girder spans.

The swing span will be operated by electrically-driven operating machinery. The 25-horsepower motors will be used for swinging, the wedges will be operated with a separate 25-horsepower motor and two 3-horsepower units will be provided for operating the rail locks. All motors will operate at 440 volts on 3 phase, 60 cycle current. Power will be obtained from the Gulf Public Service Company, whose 33,000 volt transmission line is located near the site of the bridge. A 37½ K. V. A. gasoline-engine electric generator set will be installed in the operator's house atop of the swing span to provide an auxiliary source of power for use in case of interruption of the commercial source. The operator's house will also contain the switchboard and control desk from which the structure will be operated. Drum type controllers will be provided to control the operation of the various motors. Operation of the span will be completely interlocked with the railroad signal system so that rail-locks cannot be drawn until all signals are set against railroad traffic. The sequence of operations required to open or close the span to navigation will be electrically interlocked so

that each successive operation cannot be initiated until the previous operation has been fully completed. However, sealed bypass switches will be provided to enable the operation to be accomplished in a different sequence should an emergency arise requiring a change.

The steel swing span and the approach girders will be provided with open creosoted timber decks, new 112-pound rail and 90-pound relayer rail for inner guard rails. The rail lock keys at the ends of the draw span will be manganese steel. The structure will be designed in accordance with the specifications of the American Railway Engineering Association for movable bridges for Cooper's E-60 live train loading. Tracks on the bridge will be 13 feet center to center. The elevation of low steel of the swing span will be 10 feet above mean Gulf level. Horizontal clearance provided for the navigation opening will be 75 feet between fenders. The fenders will be constructed of creosoted timber and piling. The bridge will be located so that the center of the navigable opening will be centered on the centerline of the canal. Base of rail on the structure will be at an elevation of 16.5 feet above mean Gulf level, which is approximately 2.5 feet higher than the existing base of rail.

The new bridge will be constructed in the present alignment of the railroad. A double-track shoofly will be constructed to the north of the site of the bridge for use of railroad traffic while the bridge and its appurtenances are under construction. In this manner, the new construction can be carried to completion without interruption of railway traffic.

The bridge will be constructed under contracts let by the Texas and New Orleans Railroad Company, subject to reimbursement by the United States of actual cost. Modjeski and Masters and the J. F. Coleman Engineering Company are the Consulting Engineers for the railroad company. Plans and specifications are completed and the work will be advertised in the near future.

The bridge to carry State Route No. 129 over the Charenton Drainage and Navigation Canal near Charenton, Louisiana, will consist of seven 40-foot reinforced concrete deck girder spans carried on precast reinforced concrete piling and short sections of gravel surfaced earth approach embankments. The

actual length of the concrete piles that will be used in the structure will be determined by driving and loading test piles. It is expected, however, that the pile lengths will vary from 35 to 60 feet, the longer piling being used in the channel and the shorter ones in the end bents on either bank.

The reinforced concrete deck girder spans will provide a roadway 24 feet in clear width. The roadway on the earth approach embankments will be 18 feet in clear width; the gravel surface will be 6 inches thick. The bridge was designed by Mr. N. E. Lant, Bridge Engineer of the Louisiana Highway Commission, in accordance with Louisiana Highway Commission specifications for highway bridges providing for H-15 loading. The low elevation of the reinforced concrete deck girder spans will be 15.5 feet above mean Gulf level and the elevation of crown of roadway will be 18.3 feet above mean Gulf level.

The bridge will be constructed practically in the present highway alignment. Highway traffic will be detoured to one side of the location by a temporary gravel detour route during construction of the bridge.

The bridge will be constructed under contract let by the Louisiana Highway Commission, subject to reimbursement by the United States of actual cost. Bids were opened November 1, 1939, and a contract has been entered into with Robinson & Young, the low bidder. The cost will approximate \$50,000.00.

As indicated above, the Charenton Drainage and Navigation Canal will serve the needs of navigation, as well as providing for drainage intercepted by the west protection levee. Through traffic on Bayou Teche from Morgan City to Baldwin and points west will be routed via the Intracoastal Waterway and the Charenton Canal. The distance between Morgan City and Baldwin by this route is $7\frac{1}{2}$ miles shorter than it is via Bayou Teche. Through traffic from points on Bayou Teche above Baldwin to Texas points, via the canal, will save approximately 65 miles as compared to the present route via Morgan City. A route via Six Mile Lake and the Verdunville Canal is available for local traffic from Morgan City to points on Bayou Teche between the Verdunville Canal and Baldwin. It might be pointed out that the use of the Charenton Canal and the Intracoastal Waterway for through traffic eliminates the many

sharp turns and numerous bridges encountered on the present route through Bayou Teche.

In summary, the outlet, when completed, in conjunction with Berwick Bay and the Lower Atchafalaya River, will provide for confinement of all outflow from the Lower Atchafalaya Basin to the Gulf of Mexico, and will make practicable the protection of the cultivable lands along the Teche and Boeuf ridges and the maintenance of uninterrupted service on the transcontinental routes of communication in that vicinity. Furthermore, by providing for diversion at all times through a confined channel, the completed outlet will lower stages and shorten the duration of floods in the Lower Atchafalaya Basin under practically all conditions of flow. The Charenton Drainage and Navigation Canal will provide for drainage intercepted by the construction of the West Protection Levee and will afford a navigable route for traffic on the Teche which will be blocked by the construction of the Wax Lake Outlet.

THE PRODUCTION OF MODERN PLASTIC PRODUCTS

By

HAROLD A. LEVEY *

When one observes the multitude of products both large and small which we encounter daily made from new molded materials, we realize that not only our children, but all of us are now in the "Plastic Age". To even begin to enumerate the articles that are now being made from molded plastics would probably result in a volume comparable with a dictionary, for there are now very few products indeed, which cannot be made from molded plastics.

The molded plastics industry has attained during the last decade values of major proportion with an avoirdupois which probably reaches a billion pounds annually, and with an ad valorem that approximates five hundred million dollars. This is inclusive of synthetic fibres, transparent sheeting, coating composition, and adhesives; which products might within certain limitations be included within the realms of this industry.

HISTORY

Many of the products which have so attracted our attention and play so important a role among the materials which we handle daily are plastics and date among the early materials with which man worked. Clay, brick making, chinaware, glassware, and the entire field of the ceramic arts, might come into this category. Our interest at this time, however is concerned more specifically with the organic plastic materials, and with particular reference to the newer synthetic compositions which have broadened the applications of the moldable materials into almost unbounded fields.

As last year was the centennial of Goodyear's discovery of the vulcanization of rubber, and as this was the first organic plastic material, it becomes apparent that we are really beginning the second century of molded organic plastics. At the same time, we are impressed with the fact that this product

* Member Louisiana Engineering Society; delivered at the Annual Meeting, January 13, 1940.

CLASSIFICATION OF PLASTIC MATERIALS

Types of Plastic Compositions													
Processing Properties —	Cellulose Derivatives	Phenol Aldehyde	Urea Formaldehyde	Vinyl Esters	Vinyl Acetals	Acrylic Esters	Poly-Styrne	Coumarone Indene	Casein Zein Soy Bean	Rubber	Rubber Derivatives	Shellac	Lignin
	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
	No	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes	No	Yes
	Yes Except Nitrate	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	No	Yes	No	No	No	Yes	Yes	Yes	No	No	No	No	No
	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

of nature with the addition of sulphur only, forms a thermo-setting plastic which until recently served most of the purposes required of such materials.

The next development came shortly after our Civil War, when another American named Hyatt discovered that a combination of nitro-cellulose and camphor formed a thermo-plastic moldable composition. This really marked the first completely synthetic organic product, and at the same time the first transparent plastic material. The trade name "Celluloid" has been applied to this product. This material was such an outstanding deviation from any natural product, that the next series of developments were closely related to this product, and came under the category of so-called "cellulose derivatives".

In 1908 Dr. Leo Baekeland, an American chemist of Belgian descent, evolved a new type of completely synthetic organic plastic, which has been termed "Bakelite" by the inventor, and which might be said is the parent material of the modern molded plastics industry as we know it today. This material is the result of the condensation of phenol "carbolic acid" with formaldehyde in the presence of small amount of an acid or an alkali which catalyzes, promotes, and accelerates the formation of the ultimate product.

The next step was made in the form of a contribution by the Austrian chemist, Dr. H. Pollack, after the first World War, when he produced the substance which he termed "Polopas", which is the result of the condensation of urea with formaldehyde. This type of product produced lighter color molding material than was possible by methods previously developed, and made possible the production of colorless, opaque and clear transparent almost water-white molded materials from a thermo-setting plastic composition.

The following decade produced remarkable developments in new synthetic organic products, including the several Vinyl derivatives, the Acrylic esters, and such hydrocarbon resins as the Polystyrenes, and the Coumarone Indenes. Parallel with this we observe remarkable improvements in the development of plastic made from shellac, new rubber derivatives and rubber substitutes. At the same time our knowledge of the

technique of working several important natural protein-containing materials was brought forward. Beautiful molded products made from Casein from milk, Albumen from blood, Zein from the corn kernel, and Soya Bean protein were much in evidence. Naturally, the development of other products causes a substantial shift in the importance and use of these natural materials. The factors dominating such changes lie largely within the physical and chemical properties possessed by the newer materials on the one hand, and the production costs on the other, of these various products.

PRESENT TYPES

No more vivid conception of the enormous variety of types of plastic compositions can be gained than by an even casual examination of the files of patents in the U. S. Patent Office, where the number of patents related to plastic compositions now approximate 4,000, while the actual number of basic types into which these might fall probably do not exceed two dozen. These patents cover improvements in composition, the processing operations, and the methods of manufacture. At the same time Mr. Carleton Ellis, who wrote the first authoritative and complete presentation in this country dealing with synthetic resins, and which appeared in 1923, contained five hundred pages. He has recently published a later edition of two volumes which exceeds two thousand pages. These facts from the technical aspect are definite concomitants of the growth of this industry.

METHODS OF MANUFACTURE

While the object of this presentation is to delineate the chemical engineering aspects of the plastic industry, and is presented to a group of engineers, rather than chemists, it is nevertheless believed to be fitting to at least indicate the fundamental chemical operations involved in the production of these compositions. In briefly outlining these various processing operations the sequence of presentation will be substantially in the chronological order in which they were evolved.

Rubber: The working of natural rubber consists substantially of the breaking of the latex or rubber dispersion in water, usually through the addition of some acid such as Acetic.

The coagulated product is dried and smoke cured. It is then milled with a larger amount of sulphur than is used for the production of elastic goods, and subsequently heat treated for a longer time period, thus producing what is termed "hard rubber". The objects are formed by the action of heat and pressure in suitably shaped molds. The objects are then removed and are usable as such.

Shellac: This natural gum is seldom used alone in the molded plastics field, but rather as a vehicle or binder for a major portion of filler. The mixture is subjected to hot, or even cold molding operations which produces a limited variety of products with marked limitations and uses.

Casein: From cows' and goats' milk we obtain our principal source of supply of casein by first removing the butter fat preferably by centrifugal action, and then recovering the casein by the addition of an acid, or inoculation with bacteria or ferments. This casein, after suitable purification is incorporated with a hardening or tanning agent such as formaldehyde, tannic acid, chrome alums, and the like, while suitable pigments, dyes, and fillers are milled together and subsequently molded under heat and pressure. The material then cures, and is finally polished, after which it is ready for use.

Zein: Is a protein from the kernel of corn grains, and after extraction and purification is processed in a manner similar to casein.

Albumen: This is also a protein, but its source is from blood, the whites of eggs, and the like. After purification it too is processed in a manner paralleling casein.

Soya Bean: There is produced from the many varieties of soy a protein material which possesses excellent properties as a plastic material. It can be combined with other protein products such as casein and zein, and is processed in a similar manner.

Rubber Derivatives: This group of products include a wide variety of materials such as chlorinated rubber and rubber chloride, as well as rubber hydrochloride. They are produced by acting upon natural rubber as such, or in the form of a dispersion or solution by chlorine in the presence of spe-

cific catalysts, heat, pressure and in some cases sunlight, all producing different end products. Rubber hydrochloride results from the processing of natural rubber with anhydrous gaseous hydrogen chloride in the presence of a catalyst. Under this same caption is also included rubber substitutes such as Thiokol, which is a trade name resulting from the condensation of ethylene dichloride with carbon disulfide; Chlorophene, better known under the trade name of Neoprene, which is derived from vinyl chloride, and highly polymerized vinyl derivatives. Another vinyl type of rubber substitute is sold under the trade name of Koroseal. There are of course a number of other rubber substitutes and synthetic rubbers such as Buna and the like.

Lignin: Under this classification there are a number of plastic materials originating from woody sources wherein the ligninous component of the wood becomes activated by treatment with heat and pressure in the presence of moisture or steam. The lignin becomes the binder for the cellulosic fibres which under subsequent heat and pressure becomes converted into an infusible, insoluble mass. Other modifications of this same process include the formation of additional resinous components by the inclusion of aniline and furfural, which condense when the ground woody materials are mixed with these two reagents and molded under heat and pressure into the desired form.

Coumarone Indene: This type of product is obtained from coal tar residues, and forms an excellent thermo-plastic medium of low moisture absorption, and excellent electrical values. It is made up of an aromatic ketone which combines with a bicyclic aromatic hydrocarbon, resulting in a long chain compound.

Cellulose Derivatives: This group includes probably the most diversified types of plastic products, and at the same time accounts for the largest volume of molded thermoplastic products now in use. The first product of this type was nitrocellulose, which must be combined with an addition product to render it thermoplastic. The one substance which appears to be supreme for this purpose is camphor, either natural or synthetic. During the past several years a number of other addi-

tion products have been developed which produce equivalent results. The next substance in this class is termed cellulose acetate, and appears on the American market under a wide variety of trade names such as "Lumarith," "Tenite", "Plas-tacel", "Fiberlon", etc. This material is made by the reaction of acetic anhydride on cellulosic fibres in the presence of a catalyst such as sulfuric acid or zinc chloride. In order to possess thermoplastic properties, however, it too must be dispersed in a so-called plasticizing agent which is more or less a solvent for the cellulose acetate, which solvent is of low vapor pressure at molding temperatures. Other derivatives include mixed esters of cellulose, such as the acetate butyrate and cellulose acetate stearate, which appear to possess certain advantages over the normal cellulose acetate, but hardly sufficient to warrant the substantial increase in price which these products now command. The most interesting and promising of these cellulose derivatives are the cellulose ethers, such as cellulose methyl ethers, the ethyl ethers, and the benzyl ethers of cellulose. The unique characteristic of these derivatives are that they are inherently thermoplastic, and do not require the incorporation of an addition product or plasticizing agent to render them thermo-plastic. They are produced by acting upon cellulosic material with a strong alkali solution of caustic soda resulting in the formation of soda-cellulose. This product then reacts with methyl, ethyl, or benzyl chloride as the case may be, forming the respective cellulose ether. The resulting product is then purified by known means, dried; and if plasticizing agents are added, close control of the flow of this material under heat and pressure can be readily maintained.

Phenol-Aldehyde: This type of plastic previously referred to is made from phenol, such as carbolic acid or other homologues such as cresols, the xylenols, and related derivatives, with an aldehyde such as formaldehyde, furfural, and the like in the presence of a catalyst such as an inorganic acid or alkali. A resinous-like product is formed under the action of a moderate amount of heat under a partial vacuum. If the major portion of the water resulting from this reaction is removed, a complex mixture of partially condensed products results, which include such compounds as ethyl benzene, saleginine, and the

like. On the application of further heat and pressure the condensation and polymerization is completed, and an infusible and insoluble mass results.

Urea-Formaldehyde: This important and relatively new type of resin is formed from the interaction of the two substances designated resulting in an intermediate product which flows under heat and pressure, and after a relatively short curing period is transformed into an infusible, insoluble mass. Unlike the previous type this form is available in white and pale colors, and does not discolor or yellow on ageing.

Vinyl Esters: This type of plastic is made from vinyl alcohol which is derived from acetylene, and which is converted into vinyl chlorides and vinyl acetates. These are then mixed in varying proportions, producing an ultimate product of varying plasticity.

Vinyl Acetals: These new derivatives obtained from acetylene are exceedingly complex bodies appearing in a wide variety of forms, some being very tough and flexible, while others are as elastic as rubber. The principal applications of this type at the present time are in the form of the intermediate lamination in safety glass. However, within the not distant future you will find this product made in the form of synthetic fibres with an elasticity value far exceeding that of natural silk, and closely approximating the new synthetic fibre sold under the trade name of "nylon".

Polystyrene: This hydrocarbon resin belongs to the Indene type, except that it is available in water white form and condenses differently. It is thermo-plastic and not thermo setting, has exceedingly low moisture absorption, and unique electrical values. It is obtained from coal tar residues.

Acrylic Esters: This is probably the newest type of synthetic resin which has been placed upon the American market. It is available in several forms, is water-white and of glass-like transparency. It can be prepared from petroleum gases or from glycerine. It was developed in Germany, and reached a high stage of commercial development within the last three years through the resources of the DuPont Company and Rohm & Haas, Inc.

FORMS OF EQUIPMENT FOR PRODUCTION

The classes of equipment which enter into the production of these many varieties of plastic compositions naturally vary with the types. However, there is much in common in their operation. Most of these plastic materials are of a resinous nature, and consist in the initial or partial condensation or inter-reaction of two components. The thermo-setting types usually consist in the condensation of an aldehyde with an aromatic alcohol, or with a form of substituted ammonia. A third component which does not enter into the reaction, and termed a catalyst, facilitates and accelerates the initial phase of formation.

These products may be liquids, solids or gases. At all events they are carefully metered to determine their exact proportions which usually are computed on a mole weight basis, and the catalyst added in amounts between 1% and 3% of the aggregate weight. If any component is a solid, it is either fused, or ground into a fine powder in order to facilitate speedy and complete reaction at this stage.

Reaction is usually conducted in a vacuum kettle equipped with an impellor, mixing blades or agitating device. The kettle is jacketed so that it may be heated by means of steam, hot oil or other agency to carry the necessary heat to effect the desired reaction. The reaction kettle is fully enclosed, and usually connected to a vacuum pump to remove the water vapor which results from most of these reactions. In many cases a condenser is required which removes certain secondary products of reaction which may be thereby recovered.

Careful chemical control is required, and is effected by taking samples from the kettle which are examined to determine the progress of the reaction. When condensation or polymerization has reached the desired degree, the plastic mass is discharged into cooler trays in which form it is stored for future use. No change takes place in storage. The product is removed from troughs or pigs much like cast iron. The material is then placed through several varieties of crushers, such as the swinging arm type, the ball or rod mill type, or the pivoted jaw type, as the nature of the plastic resin may require. Only so-called resins are processed in this fashion. The

cellulose derivatives as well as the rubber products are precipitated in water in exceedingly finely divided form, and do not require any grinding operation at this stage.

The resin type of plastic material is then weighed along with such additions as fillers, pigments and dyes, when it passes over a magnetic separator, and is further cominuted in a pulverizing mill of the screw-fed or rotating screen types.

This mixture is then compounded by passing the mixture between a series of rolls of the type used in paint mixing plants, which thoroughly incorporates the addition products referred to, rendering the mass uniform and homogenous. The compounding mill usually develops a substantial amount of heat, raising the temperature close to the melting range of the resinous mixture. As a result, this mass has to be cooled down while it is being transferred to another crusher, which breaks up the large lumps, then through a magnetic separator for the removal of the ferrous particles to a grinder, which reduces the mass to particles to about the size of grains of rice. These are then passed over a screen, which separates particles larger than $3/16''$ in diameter by $5/16''$ long, and returns them to the grinder to be reduced to within this size. The dust is returned to the compounding mill, and incorporated with the next batch. The colors are then blended to obtain intermediate shades or mottled effects as the consumer may require.

The material is then packaged in metal containers after suitable inspection and testing. Great care is taken to make certain that the molding material is free from even minute traces of particles of iron and abrasive material, as such foreign matter would have a destructive effect on the inner surface of the molds. These operations complete the processing conducted by the plastic manufacturer. This intermediate product is shipped to molders, who convert these granular products into the ultimate form in which they are to be used by the public. If the resin is of the thermo-setting type, the granules are placed in the hopper of a "Pre-forming Machine", which measures out a predetermined weight of the plastic material, and presses it into a form which will fit inside of the open and divided mold in the compression molding machine. The halves of the mold are closed, and the heat and pressure

turned on for a matter of a minute or two. The mold is then partially opened to release the gases and vapors which are formed as a result of the final reaction. The molds are again closed and the pressure and heat applied for five to thirty minutes, depending upon the chemical composition of the resin, its size, as well as the thickness of the parts which make up the final product. The mold is then opened, and the molded object discharged from the bottom half by means of knock-out rods.

The object is then discharged into a receptacle where it is allowed to cool. The flash is then trimmed by manual means, after which the object is either ready for the consumer or assembled as part of another device.

If injection molding is the method used, and at present it is used only for thermoplastic types of composition, then the molding powder is placed in a hopper, and fed by means of a screw conveyor to a chamber which is usually electrically heated, and which brings the plastic material to a temperature such that it will flow under suitable pressure. The machine is equipped with a plunger which exerts pressures from 5,000 to 30,000 lbs. per square inch, forcing the material through a small orifice into the runners of the mold, and filling the cavities of the mold, thus forming the objects desired. The mold is heated by means of hot oil, or hot water under pressure. When the mold has been filled with the plastic composition, the heating fluid is immediately pumped out, and replaced with a refrigerating fluid such as brine, thus cooling the mold, and the molded products to temperatures such that they have obtained sufficient rigidity to sustain their form without warping or distortion. They are removed from the mold by means of knock-out plungers, and the runners removed from the objects. The runners are passed to a grinder which reduces them to the same size as the original molding powder or granules, so that they may be re-used and are of value equivalent to the new material.

The Phenol-Aldehyde type can be prepared in a form which makes it especially suitable for "casting" into its ultimate shape. The resin is prepared and removed from the reaction kettle, and fillers, dyes and pigments added as the case may require, when it is poured into molds much the same as metals

are cast. The molds are usually made from lead, and more recently from rubber. They are fabricated by dipping a rod, or the form of object desired attached to a rod, all of which is made from alloy steel, into the mass of molten lead. This lead coated assembly is then removed and the lead allowed to cool, and then stripped from the steel around which it encases. This method while it has limitations, is able to fabricate a form of product not possible with compression or injection molding. It is used to cast sheets, rods and tubes, which are usually subsequently machined or fabricated into the desired shape or object. A variety of novelty effects such as mottles, striates, and the like are possible by only this method.

Special shapes for structural purposes can be fabricated by the "extrusion" method, which is used for the production of rods, tubes, and shapes of irregular section and of any desired length. Fountain pen barrels, and mechanical pencils consume the bulk of plastic material made by this method.

These plastic compositions are also used to impregnate fabrics, paper, fibreboard, wood veneer, and the like, which may either be bonded together under heat and pressure, or into other surfaces, producing a wide variety of useful and novel effects. These products are usually termed "laminates".

ADDITION PRODUCTS

Like nearly all of our commercial products, these plastic materials are seldom pure substances, and nearly always are made up of mixtures of the basic plastic material itself with a wide variety of addition products. These added materials usually consist of the types of substances listed below.

Plasticizers: With several types of plastic composition we find it necessary to incorporate a product which contributes flexibility or plasticity to the mixture. Several types of plastic products owe their plasticity to the addition of these compositions. They are usually classified as solvents for the plastic product, and dominate to a large extent the temperature and pressure at which the mixture will possess the correct flow characteristics to function properly in standard molding machines. These conditions are especially applicable in the case

of thermo-plastic compositions such as those containing the cellulose derivatives, rubber and rubber derivatives, lignin plastics, and in some conditions include such hydrocarbon resins as polystyrene and coumarone indene. An interesting aspect of plasticized resins are the vinyl esters which are made up of a mixture of vinyl chlorides which are brittle, and vinyl acetates which are quite soft. By varying the proportions of these two components, a wide range of plasticity conditions may be obtained.

In the case of the vinyl acetals the plasticity of the ultimate product is obtained in the processing operation regulating the degree of polymerization in the ultimate product.

Pigments: Colored opaque plastics are obtained by grinding pigments similar to those used in the paint industry, and usually consisting of oxides or salts of the heavy metals, with the resins on a multi-roll compounding mill similar in many respects to those types now used in the paint and rubber industries. Considerably smaller amounts are used, however, than prevail in paint formulation, which usually requires a pigment content of 70% by weight, while possibly one-tenth of this amount is usually adequate for properly coloring plastics. However, if complete opacity is desired in thin walled construction, a content of approximately 30% may be required.

Dyes: When colored plastics are desired, and at the same time it is necessary to maintain the transparency of the plastic, suitable dyestuffs are used to tint or color the resin. There are many types of dyes which have the desired degree of affinity for the several types of resins, and which conditions simulate those which prevail for the dyeing of textile goods. The dyes are usually incorporated by dissolving them in a minimum volatile organic solution which is compatible with the resin, and the mass milled on a compound roll mill such as described above for pigments. Usually a fraction of 1% by weight of a good grade of dyestuff of high tintorial strength is adequate to give satisfactory depth of color to the plastic material.

Metallics and Pearl Effects: A scintillating or iridescent type of surface is obtained by incorporating small particles of aluminum flakes or the various types of metallic bronze par-

ticles in the plastic mass, which is milled with the resin as described above. Almost limitless varieties of novelty effects are obtained by the blending of various amounts of these metallic flake pigments with dyes. Similar results are also obtainable through the use of both natural and synthetic pearl essence, which simulates the pearl and the fish scale type of iridescence.

FILLERS AND IMPREGNATION

Where transparency is not essential, and where it is desired to reduce the cost of the ultimate molded material, as well as increase its strength in many cases, a wide variety of fillers are used. Where resistance to high temperatures are desired, there is incorporated with the plastic carefully graded asbestos fibres which result in an increase in strength, as well as temperature resistance and improved impact values. Probably the most extensively used filler is finely ground cellulose material designated as "wood flour". In the lignin plastics we have a composition made up of cellulosic fibres which are bound together by lignin, and are obtained in that form in the processing of this type of plastic composition. Other types of fillers include china clay, talc, diatomaceous earth, and the like. Many of the low priced pigments are frequently used in sufficiently large amounts to be designated as fillers when they are not added as a coloring agent.

Resins of the thermo-setting types when in their intermediate stage, and when dissolved in suitable solvents, are used to impregnate forms of fabrics, paper, fibreboard, and wood. The volatile solvents are allowed to evaporate, and as many laminations as are desired are laid together between the platens of a hydraulic press. Pressures of from 200 to 2000 lbs. per square inch are applied, and temperatures which will convert the thermo-setting resin into the infusible type. There results a slab of exceedingly tough, strong and durable structural material substantially inert, highly resistant to moisture, abrasion and chemical erosion. These products are uniquely suited for table tops, flooring, door and wall panels, and similar structural uses, as well as for the construction of silent gears and many types of machine parts. A most superior type of plywood or wood veneer, wholly unaffected by moisture even on water

emersion, is made up in this fashion, from which is constructed a variety of furniture heretofore unknown for its durability, utility, strength and longevity.

CHOICE OF TYPES AND THE ECONOMICS OF THEIR SELECTION

Realizing the versatility of these many types of plastic products, their inherent properties, the methods of manufacture, and their costs, the question which then confronts is: when and where, as well as why do we use these many forms for as many purposes? When specific characteristics are desired, and which are largely met by a certain type of plastic, the matter of choice is promptly removed, and decision is easy. Notwithstanding the many desirable characteristics of these plastic compositions, there are still many industrial requirements at the present time which cannot be satisfactorily met. Much hope and optimism prevails that plastics will be forthcoming which will meet these requirements. As price is frequently a dominating factor where the profit system prevails, and where drastic requirements are not laid down by the producer of many articles of commerce, we would probably find the manufacturer selecting the ligning plastics as his material of construction. If the product will permit the increase in cost, the use of the phenol-aldehyde or the urea-formaldehyde types might be used. These of course permit more intricate molding, thinner walls, a greater variety of color effects, and in all probability an ultimate product of a higher degree of sales acceptance. If many thousands of articles of one type are to be produced, the high cost of the molds will no longer become a substantial factor of unit cost per object produced, and injection or compression molding may be used. For small objects injection molding is usually the more economical. However, as a general rule only thermo-plastic types of resins can be used for injection molding operations. Several types of thermo-setting plastics are being successfully modified to permit of injection molding, and thus enter this field of use.

Where only a relatively small and limited number of molded objects are required of any one type, obviously the cost of molds would be prohibitive. In such cases the cast plastics are used for such purposes, the phenolic types are supreme in

this field of application. When only one or two of a type are required, the object is usually machined from a slab or billet of a cast phenolic resin in view of the fact that material in this form is subject to the same machining operations as the metals, and with equal facility.

For complete transparency and lack of color, one is restricted to the use of the acrylic esters, the polystyrene resins, and possibly several of the cellulose derivative plastics. Similar limitations prevail when plastics are selected for the electrical industry, which obviously requires such values as high dielectric strength, high specific inductivity, good power factor values at high frequencies, resistance to surface arcing, and minimum plastic flow at high temperatures. This requires low moisture absorption, high surface resistance, and freedom from conductivity spots. The chemical industry usually requires inertness to most chemical reagents, complete insolubility in the wide range of organic solvents, as high a heat transmission value as can be obtained with organic materials of this type, minimum warpage and distortion under operating conditions, and related characteristics. Rubber and certain of the rubber derivatives approximate these requirements more than the other plastic materials. For structural purposes initial low cost appears to be of primary interest, while such other properties as high tensile and transverse strength, toughness, resistance to surface abrasion, highly polished surfaces, and preferably light colors would probably include the basic requirements for this field of application. The lignin plastics, the phenol-aldehyde type carrying a major portion of low price filler, and possibly the urea-formaldehyde variety composed of an equally large amount of filler are the salient competitor for this field of application. Buttons, toys, pennyroyal for the 5¢ and 10¢ stores utilize a limited amount of casein, a large amount of phenol-aldehyde as well as the urea-formaldehyde types, while the cellulose derivatives find their way to this trade largely through their use in making up important elements of the toilet goods trade. Extensions of these applications take place from time to time. Obviously, there is a marked overlapping of these products and their applications. It is interesting to note at this time the more extended use of

reclaimed plastics for remolding and re-fabrication. This sphere of activity will grow from time to time. However, only thermo-plastic types of resins are applicable for reclaiming and re-use.

TRENDS IN THE DEVELOPMENT OF PLASTIC PRODUCTS

While the salient aspirations of the workers in the field of plastics are usually included in the conception of "better plastics at lower prices", investigations of the new patents as issued reveal searches for new types possessing physical and chemical characteristics not inherent in the present known varieties. These workers seek a plastic composition with the inherent characteristics of the thermo-setting type, yet permitting the manufacturing operations of the thermo-plastic form. Completely water-white color and transparency are sought along with high tensile and transverse strength, and substantial impact resistance. While many of these qualities are now possessed by several of the types described above, the relative high costs of these forms probably militate in a major way against their more extensive use.

With our present movement toward the utilization of what we have in abundance usually from waste or surplus farm products, we will probably note the more extensive use of both the lignin types of plastics as well as those derived from protein sources such as casein, zein, the soy, cottonseed and peanut proteins. Because of the relatively low cost of these types, they will probably play an important role as structural materials in the makeup of both our houses, as well as the furniture contained therein. At the present time, molding facilities definitely limit the dimensional values of molded plastics. We are of course using molded materials made from woody sources for the construction of our homes and furniture, but in order to utilize all the advantages of molded plastics, it becomes necessary to turn out these objects on a mass production basis, where the elements are molded in their final form in a single operation, carrying inserts or so designed that the parts may be readily assembled into the finished object. While these requirements involve standardization to a high degree, it is believed that the American public would accept these prere-

quisites attracted by the outstanding utility, beauty, longevity, and low cost that will result from the adoption of these methods and procedure.

Already we visualize the trend toward the extension of the use of various plastic materials in the production of small boats, the bodies of automobiles, and assembled from small units much of the metal construction on airplanes which may be replaced with molded plastic materials.

Thus our wildest dreams might readily come true through the extended and varied uses of molded plastics for almost every function of our existence making up as it does our shelter, our clothing, our implements, and even certain of our foods might be classified as "molded plastics".

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MEMBERSHIP LIST

C. M. : Charter Member
H. M. : Honorary Member
L. M. : Life Member
L. A. : Local Associate Member
L. Aff. : Local Affiliate Member

N. R. Aff. : Non-Resident Affiliate Member
J. : Junior Member
N. R. J. : Non-Resident Junior Member
S. : State Member

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- SAM VERNON APPLEWHITE, (1927), Engineer, Geo. P. Rice Company, New Orleans.
- WILBERT N. ARGUS, (J.), (1938), Sales Engineer, 317 Baronne St., New Orleans.
- J. E. ARNOLD, (938), Instructor Mechanical Engineering, Tulane Univresity, New Orleans.
- G. G. AUROLES, (N. R. J.), (1938), Chemical Engineer, Proctor & Gamble Company, A 459 Vedado, Havana, Cuba.

— B —

- JEROME C. BAEHR, (1930), Assistant Engineer ,U. S. Engineers, 2nd N. O. District, foot of Prytania Street, New Orleans, La.
- JOHN C. BAINE, JR., (1938), Superintendent of Equipment, New Orleans Public Service Inc., 2838 Iberville St., New Orleans.
- MARSHALL BALLARD, JR., (Aff. M.), (1937), 605 United Fruit Bldg., New Orleans.
- CHARLES CLIFTON BARNARD, (1937), In Charge Union Station Project. Address: 1603 Broadway, New Orleans.
- WADE BARNETT, (L. M.), (1910), Civil Engineer, Sewerage and Water Board, 6117 Loyola Ave., New Orleans.
- JOHN C. BARTLEY, (J.), (1939), City of New Orleans Assistant Engineer, City Engineer's Office, 2303 Joseph St., New Orleans.
- RAYMOND P. BASSICH, (L. 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.

- R. H. BAUMBACH, (L. Aff.), (1911), Manager, Eugene Dietzgen Co., 318 Camp St., New Orleans.
- V. J. BEDELL, (1936), Chief Engineer, New Orleans Public Belt Railroad, 502 Pine St., New Orleans.
- BEN H. BELL, (1920), Operating and Electrical Engineer, New Orleans Public Service Inc., 4604 S. Derbigny St., New Orleans.
- MACE HUDSON BELL, (1937), Engineer, A. I. S. C. Inc., 506 Stern Bldg., New Orleans.
- CHARLES A. BENDER, JR., (L. A.), (1933), Lubrication Engineer, Gulf Refining Co., 1729 Marengo St., New Orleans.
- JOHN C. BENDLER, (J.), (1938), Engineer, 8815 Apricot St., New Orleans.
- R. F. A. BENSON, (1938), Assistant Division Manager, Gulf Refining Company, Maison Blanche Bldg.
- JOHN H. BERNHARD, (N. R.), (1922), Consultant for Harbors and Water Ways, Salisbury, Somerset Co., Penn.
- F. N. BILLINGSLEY, (1915), Consulting Engineer, Billingsley Engineering Company, 409 Interstate Bank Bldg., New Orleans.
- CLEM BINNINGS, (J.), City Engineer's Office, New Orleans.
- A. L. BLACK, JR., (N. R.), (1931), Engineer, Ford, Bacon & Davis, Inc., 39 Broadway, New York City.
- ALBERT R. BOELTE, (J.), (1937), Structural Designer, Dock Board, 6057 Patton St., New Orleans.
- CLARENCE NICHOLAS BOTT, (1927), General Contractor, 608 Audubon Bldg., New Orleans.
- S. C. BOUCHE, (J.), Engineer, 2035 Nashville Ave., New Orleans.
- HAL M. BOURG, (S.), (1939), Chief Map Draftsman in Charge of Map Department, La. Hwy. Comm., 730 Boyd Ave., Baton Rouge, La.
- JASPER L. BOURGEOIS, (N. R.), (1938), Parish Engineer, Jefferson Davis Parish, Welsch, La.
- SHIRLEY C. BRASELMAN, (1919), Vice-President, American Creosote Works, 1305 Dublin St., New Orleans.
- ERIC P. BREIDENBACH, (J.), Celotex Company, New Orleans, La.
- EDWARD S. BRES, (1925), Scott & Bres, Contracting Engineers, 311 Maritime Bldg., New Orleans.
- A. W. BRODTMAN, (S.), Civil Engineer, P. O. Box 574, Franklin, La.
- JAMES P. BRODTMAN, (L. Aff.), (1932), Gulf States Creosoting Co., 901 United Fruit Bldg., New Orleans.
- AUGUST J. BRODTMANN, JR., (J.), (1936), Property Accounting Engineer, New Orleans Public Service Inc., 317 Baronne St., New Orleans.
- THOMAS G. BROUSSARD, (J.), (1939), Engineer, La. Power and Light Co., 105 N. Third St., Monroe, La.
- A. R. BROUSSEAU, (1935), General Contractor, 1915 S. Dupre St., New Orleans.
- HARWOOD I. BROWN, (S. J.), (1937), Draftsman, Freeport Sulphur Co., Port Sulphur, La.
- LAWRENCE C. BRUNE, (1933), Engineer, Federal Land Bank, 2546 Conti St., New Orleans.
- WILLIAM P. BRYAN, (S.), (1939), Squad Leader with La. Hwy. Comm., Coolidge St., Rt. No. 4, Baton Rouge.
- LOUIS B. BUJA, (1922), Construction and Civil Engineer, 7820 Spruce St., New Orleans.
- J. T. BULLEN, (S.), (1925), Area Engineer, W. P. A., Monroe, La., P. O. Box 1692.
- J. J. BULLIUNG, (1915), Engineer, Market Street Power House, New Orleans.
- R. T. BURWELL, (1908), Manager, New Orleans Department, Hartford Steam Boiler Inspection and Insurance Co., 610 Masonic Bldg., New Orleans.

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- PETER B. CALLAC, (J.), (1937), Instrumentman for Sewerage and Water Board, 7842 Apricot St., New Orleans.
- ROY M. CAMI, (S. J.), (1939), Soil Conservation Service, C. C. C. Camp, Thibodaux, La.
- PHILIP HOPE CAMPBELL, (1925), Technical Engineer, with Federal Barge Lines, 6041 Ferrier St., New Orleans.
- C. GLENN CAPPEL, (1915), Vice-President, W. Horace Williams Co., Inc., Engineers and General Contractors, 833 Howard Ave., New Orleans.
- MARTIN CARBONELL, (1938), Assistant Engineer, U. S. Engineer's Office, Foot of Prytania St., New Orleans.
- J. B. CARTER, (S.), (1939), Assistant Bridge Construction Engineer, La. Hwy Comm., Baton Rouge.
- WILLIAM H. CARTER, (S.), (1938), Assistant Professor of Agricultural Engineering, L. S. U., 238 State St., Baton Rouge.
- CHARLES E. CASSAGNE, JR., (1937), Civil Engineer, 164 Delaronde St., New Orleans.
- WILLIAM A. CASTILLE, (1939), District Engineer, Humble Oil Co., 2307 American Bank Bldg., New Orleans.
- N. S. CATCHINGS, (S.), (1939), Civil Engineer, P. O. Box 532 Baton Rouge, La.
- D. B. H. CHAFFE, JR., (S.), (1920), Partner, Southern States Equipment Co., 425 Celeste St., New Orleans.
- NEIL L. CHAVIGNY, (N. R. J.), (1939), Engineer, Bay City, Texas.
- THEO CHENET, (S.), (1922), Surveyor, Thibodaux, La.
- H. M. CLANTON, (S.), (1935), Office Engineer, Lake Charles, La.
- ANGUS B. COBB, (S.), (1939), Senior Draftsman, La. Hwy. Comm., 354 Bedford Drive, Baton Rouge.
- EARL C. COBURN, (S. Aff.), (1939), Supervisor of Installations of Heating and Ventilating Equipment, 2175 Wisteria St., Baton Rouge.
- AUBREY G. CODE, (1933), Junior Engineer, S. S. Engineers, 1st N. O. Dist., 4926 Mandeville St., New Orleans.
- J. F. COLEMAN, (Jan. 1, 1898), (C. M. and H. M.), of J. F. Coleman Engineering Co., Consulting Engineer, 1023 Carondelet Bldg., New Orleans.
- JAMES HOWARD COLLINS, (1929), General Outdoor Advertising Co., 2120 Canal St., 1310 Short St., New Orleans.
- J. B. CONVERSE, (N. R.), (1921), Consulting Engineer, J. B. Converse & Co., Engineers, Mobile, Ala.
- ALFRED JOSEPH COOPER, JR., (N. R. J.), (1934), T. V. A., 2106 N. Broadway, Knoxville, Tenn.
- CHARLES A. COOPER, (S.), (1939), Roadway Draftsman, La. Hwy. Comm., R. F. D. No. 1, Baton Rouge, La.
- LINTON C. COOPER, (S.), (1939), Bridge Dept., La. Hwy. Comm., 942 Convention St., Baton Rouge, La.
- ERNEST A. COULOHERAS, (1933), Civil Engineer, 2627 Peniston St., New Orleans.
- JOSEPH F. COURTNEY, (1930), Assistant Superintendent, International Harvester Company, 50 Fontainebleau Drive, New Orleans.
- E. L. COWAN, (S.), (1938), Engineering Department, Gaylord Contalner Corp., 701 Superior Ave., Bogalusa, La.
- JOHN E. COYNE, (S.), (1938), Assistant Engineer of Construction, La. Highway Comm., 735 Rupp St., Gretna, La.
- MARTIN J. CRAMER, (S.), Senior Highway Engineer, Bureau of Public Roads, 323 Post Office Bldg., Baton Rouge, La.
- CHARLES C. CRAWFORD, (1921), Vice-President, A. M. Lockett & Co., 1315 First St., New Orleans.

- L. VILLERE CRESSY, (L. Aff.), (1930), Sales Engineer and Representative for C. A. Dunham Co., and Modine Mfg. Co., 1666 Abundance St., New Orleans.
- HORACE E. CRUMP, (L. M.), (June 8, 1906), Office Engineer, Dock Board, No. 2 Canal St., New Orleans.
- LIONEL J. CUCULLU, (1928), Sales Engineer, New Orleans Public Service Inc., 4630 Arts St., New Orleans.
- DAVID L. CULLOM, (1916), Assistant Engineer, Board of Commissioners of the Port of New Orleans, 4032 Prytanla St., New Orleans.

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- ISAAC C. DANIELS, (1937), Board of State Engineers, 3906 Louisiana Ave. Parkway, New Orleans.
- FRANCIS E. DAVID, JR., (1937), Junior Engineer, War Department, Corps of Engineers, Second New Orleans District, New Orleans.
- ORRIS J. DAVIESON, (1937), Mechanical Engineer, Assistant Director, Delgado Trades School, 3101 Milan St., New Orleans.
- ALBERT B. DAVIS, JR., (N. R.), Assistant Engineer, Corps of Engineers, Galveston District, 1101 23rd St., Galveston, Tex.
- B. N. DAVIS, (1913), Engineer and Contractor, 1006 Tchoupitoulas St., New Orleans.
- GEORGE H. DAVIS, (L. M.), (Oct. 14, 1909), Director, Ford, Bacon & Davis, Inc., 39 Broadway, New York City.
- DONALD DERICKSON, (1912), Professor of Civil Engineering, Tulane University, New Orleans.
- L. DEVALL, (1935), 2120 Milan St., New Orleans.
- CHARLES B. DICKS, JR., (1936), Consultant and Chemical Advisor to Specialty Products Co., New Orleans.
- STANLEY DIEFENTHAL, (J.), (1939), Engineer, 1920 Broadway, New Orleans.
- C. E. DOLHONDE, (1939), Design Draftsman, care Shell Petroleum Corp., Norco, La.
- BERNHARD DORNBLATT, (1937), Field Engineer, Portland Cement Association, P. O. Box 254, New Orleans.
- WILLIAM JOSEPH DRAWE, JR., (1933), Engineer, New Orleans Public Service Inc., 4235 Gen. Pershing St., New Orleans.
- ROBERT J. DRUEDING, (1935), Assistant Chief Engineer, Orleans Levee Board, 4455 Lafayette St., New Orleans.
- LOUIS DUCLOS, (S.), (1939), Bridge Designer, La. Hwy. Comm., P. O. Box 193, Baton Rouge, La.
- ARCHIBALD LEE DUNLAP, (1925), Associate Professor of Mechanical Engineering, Tulane University, 1318 Nashville Ave., New Orleans.
- THOMAS T. DUNN, (N. R.), (1938), Chief Engineer, Gaylord Container Corp., P. O. Box 1146, Bogalusa, La.
- B. H. DUPUY, (1932), Designer Mechanical Appliances, 1421 Harmony Street, New Orleans.
- ALLAN T. DUSENBURY, (L. M.), (May 25, 1909), Consulting Engineer, 1607 American Bank Bldg., New Orleans.
- J. O. DYAL, (N. R.), (1937), Civil Engineer, Puerto Cabezas, Nicaragua.

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- GEORGE G. EARL, (L. M.), (Jan. 1, 1900), Consulting Engineer, 1419 Henry Clay Ave., New Orleans.
- RALPH EARL, (1913), 3216 Cockerell St., Fort Worth, Tex.
- JOHN T. EASTWOOD, (L. M.), (Jan. 8, 1901), Consulting Engineer, 1926 Milan St., New Orleans.

- FRANK W. EDWARDS, (N. R.), (1937), Hydraulic Engineer, P. O. Box 1176, Ancon, Canal Zone.
- JOHN P. EGAN, (L. Aff.), (1931), Assistant Chief Engineer in Charge of Maintenance and Operation for New Orleans Public Service Inc., at Market Street Steam Electric General Station, 5436 S. Claiborne Ave., New Orleans.
- L. P. ELBERSON, (S.), (1911), Chief Engineer, Louisiana Irrigation & Mill Co., Crowley, La.
- S. W. ELBERSON, (S.), (1911), Vice-President and General Manager, Louisiana Public Utilities Co., Lafayette, La.
- DANIEL STANLEY ELLIOTT, (1921), Professor of Physics, Tulane University, New Orleans.
- O. H. ELVERUM, (S.), (1936), Engineer, Manager Breaux Hotel, 610 First St., Morgan City, La.
- ERIC L. ERICKSON, (S.), (1937), Assistant Bridge Engineer, Louisiana Highway Commission, Baton Rouge, La.
- CHARLES D. EVANS, (1936), Resident Engineer, Inspector, P. W. A., 2108 Broadway, New Orleans.
- JAMES P. EWING, (1915), Vice-President and General Manager, Doullut & Ewing, Inc., 3503 Prytanla St., New Orleans.

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- FRANK J. FAVA, (S. J.), (1939), Junior Engineer, La. Dept. of Conservation, Eagle Hotel, Villa Platte, La.
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- FRED H. FENN, (1930), Instructor, College of Engineering, L. S. U., 204 Church St., Baton Rouge, La.
- CHARLES FENSTERMAKER, (1914), Chief Engineer, Industrial Lumber Co., Eliza-beth, La.
- ARTHUR J. FERGUSON, (S. J.), (1938), Inspector, Standard Oil Co., 604 Boyd Ave., Baton Rouge, La.
- HUBERT A. FLANAKIN, (S.), (1939), Webster Parish Hwy. Dept., Minden, La.
- HARRY W. FLETCHER, (L. Aff.), (1937), President, Fletcher Equipment Co., Inc., 309 Magazine St., New Orleans.
- LIONEL E. FLOTTE, (L. Aff.), (1939), District Manager, United Cork Co., 1114 N. Dorgenois St., New Orleans.
- J. THAD FLOYD, (1938), Structural Engineer, Ingalls Iron Works Co., 811 Masonic Temple, New Orleans.
- ALLEN K. FORD, (J.), (1937), Sewerage and Water Board as Topographical and Mechanical Draftsman, 526 Carondelet St., New Orleans.
- JOHN D. FORD, (1937), Inspector, Hartford Steam Boiler Insurance Company, 2431 State St., New Orleans.
- JACQUES L. FORTIER, (J.), (1938), Engineer, Sales Engineer, Mundet Cork Co., 432 N. Peters St., New Orleans.
- FREDERICK H. FOX, (1922), Associate Professor, Civil Engineering, Tulane University, New Orleans.
- ALBERT J. FRANSEN, (J.), (1934), Metal Trades Co-ordinator, N. Y. A., 201 Ring-gold St., New Orleans.
- LOUIS T. FRANTZ, (1936), Electrical Engineer, Sewerage and Water Board, 8735 Apricot St., New Orleans.
- ERNEST M. FREEMAN, (S.), (1939), Consulting Engineer, 403 City Bank Bldg., Shreveport, La.
- ALVIN M. FROMHERZ, (1915), Consulting Engineer, 226 Carondelet St., New Orleans.
- FRANK G. FROST, (1919), General Superintendent, Electrical Dept., New Orleans Public Service Inc., New Orleans.
- DONALD E. FUELLHART, (S.), (1939), Civil and Petroleum Engineer, La. Dept. of Conservation, Natchitoches, La.

— G —

- HERBERT M. GALLAGHER, (1921), State Engineer, E. R. A., Associated with J. F. Coleman Engineering Co., 1951 Calhoun St., New Orleans.
- PATRICK E. GARNER, (S.), (1939), General Engineering Practice, Garner Bros., P. O. Box 41, Gulfport, Miss.
- JOHN B. GATES, (S.), (1937), Parish and Field Engineer, W. P. A., Pollock, La.
- FRANK G. GAULT, (S.), (1938), Engineer, P. O. Box 553, Lake Charles, La.
- JOHN S. GENTILICH, (1933), U. S. Waterways Experiment Station, Vicksburg, Miss.
- F. J. GERMANO, (S.), (1937), Assistant Professor of Mechanical Engineering, L. S. U., University, La.
- EDWARD H. GESSNER, (N. R. J.), (1933), Engineer, Martin Engineering Co., Apt. 370, Maracaibo, Venezuela.
- JOHN HARRY GILLUM, (S.), (1934), Process Engineer, Standard Oil Co., Jackson, La.
- HOWARD W. GLEASON, (1938), Engineer, Glover Construction Co., 111 Bellaire Drive, New Orleans.
- JOHN A. GLOVER, (1938), Assistant Superintendent, George J. Glover Construction Co., New Orleans.
- DAVID WALKER GODAT, (1924), Civil Engineer, Maintenance Engineer, Division of Public Works, City of New Orleans, 7826 Zimple St., New Orleans.
- JULES GODCHAUX, (L. M.), (Jan. 1, 1899), Vice-President and Engineer of Operation, Godchaux Sugars, Inc., 1007 Masonic Temple, New Orleans.
- MAYER GODCHAUX, (1938), Vice-President, Godchaux-Inshaw Corp., 500 Balter Bldg., New Orleans.
- WALTER GODCHAUX, (1938), Assistant Engineer at Godchaux Sugars Refinery, Reserve, La.
- JOSEPH McCORMACK GONDRAN, (1924), Structural Engineer with Jones & Laughlin Steel Corp., Box 66, New Orleans.
- ROBERT E. GOSA, (1929), Vice-President, W. Horace Williams, Inc., 833 Howard Ave., New Orleans.
- BERNARD GRAFF, SR., (1939), Mechanical and Electrical Engineering and Constructing, 8207 Jeannette St., New Orleans.
- ARTHUR A. GRANT, Consulting Engineer, 1543 Canal Bank Bldg., New Orleans.
- WALTER H. GRANT, JR., (1938), Sales Engineer, Sloan Valve Co., Duriron Co., Fulton Sylphon Co., Ric Wil Co., Warren Webster Co., 704 Baronne St., New Orleans.
- WALTER K. GRANT, (1922), 1527 Audubon Blvd., New Orleans.
- CHARLES H. GREEN, Woodward-Wight Co., New Orleans.
- W. B. GREGORY, (1907), H. M., C. M., Engineer Examiner, P. W. A., 630 Pine St., New Orleans.
- B. H. GREHAN, (1914), Vice-President of Geo. J. Glover Co., Inc., 1670 Soniat St., New Orleans.
- FRANCIS B. GREVENBERG, (1935), Civil Engineer, 532 Royal St., New Orleans.
- WALLACE V. de GRUY, (J.), (1939), Cost Analysis, New Orleans Public Service Inc., 2539 Jonquill St., New Orleans.
- W. S. GUEDRY, (S.), (1939), Resident Engineer, La. Hwy. Comm., 315 St. Louis St., Baton Rouge, La.
- MARIO R. GUELL, (S.), Chief Draftsman, Gaylord Container Corp., Bogalusa, La.
- JOHN M. GUILLORY, (1928), Sales Supervisor, New Orleans Public Service Inc., 4128 Monroe St., New Orleans.
- A. H. GUILLOT, (1917), Roadway Engineer, New Orleans Public Service Inc., 317 Baronne St., New Orleans.

- DONATO E. GUIZA, (J.), (1939), Boh Bros. Construction Co., 1609 S. Gayoso St., New Orleans.
- MARTIN M. GURTLE II. (J.), (1937), Chief Engineer, Le Mieux Bros., Inc., Maritime Bldg., New Orleans.

— H —

- EDGAR J. HAAS, (J.), (1937), Oliver Van Horn, 3101 Napoleon Ave., New Orleans.
- JOHN A. HAASE III, (1933), Buyer, U. S. Treasury, 9015 Nelson St., New Orleans.
- R. N. HABANS, (J.), (1939), Engineer, 2817 Grande Route St. John, New Orleans.
- ALLEN S. HACKETT, (1912), Consulting Engineer, 454 Walnut St., New Orleans.
- CALLENDER FAYSSOUX HADDEN, (1928), Secretary-Treasurer, Standard Supply & Hardware Co., P. O. Drawer 620, New Orleans.
- E. J. HAGSTETTE, JR., (S. J.), (1935), Engineer, Conservation Commission, 617 Jefferson St., Lafayette, La.
- DANIEL HALLARON, JR., (1939), Engineer, New Orleans Public Service Inc., 317 Baronne St., New Orleans.
- FARRAR PETRIE HAMILTON, (1915), Civil Engineer, 408 Walnut St., New Orleans.
- GEORGE HAMMETT, (1920), Assistant Sales Manager, A. M. Lockett & Co., 303 Whitney Bldg., New Orleans.
- ERIC J. HANEMANN, (N. R. J.), (1933), U. S. Geological Survey, Jackson, Miss.
- BEN J. HANEY, (J.), (1939), Draftsman, Sewerage and Water Board, 8007 Flg St., New Orleans.
- HOWARD J. HANSEN, (1938), Engineer with Southern Pine Association, 7315 Dominican St., New Orleans.
- WILLIAM HARDY, (1937), Engineer, 2014 Marengo St., New Orleans.
- ALLAN J. HARRIS, (1924), President, Walter Castenado, Inc., 329 Balter Bldg., New Orleans.
- VAN E. HART, (J.), Engineer, 4729 Carondelet St., New Orleans.
- M. V. HAULARD, (L. M.), (Jan. 13, 1906), Superintendent, Municipal Repair Plant, 4154 Iberville St., New Orleans.
- WILLIAM WALLACE HAY, (1928), Technical Engineer, Inland Waterways Corporation, 211 Camp St. New Orleans.
- SIDNEY L. HEBBRARD, (S.), (1939), Squad Leader with La. Hwy. Comm., 1260 University Ave., Baton Rouge, La.
- GEORGE A. HEFT, (J.), (1939), Design Engineer, Union Station Project, New Orleans.
- NUMA J. HELWICK, (1936), Engineer with American Heating & Plumbing Co., 809 Greenwood St., New Orleans.
- HARDY B. HENDERLITE, (S.), (1929), Engineer, Louisiana Highway Commission, Baton Rouge, La.
- JAMES P. HENDERSON, (1938), District Erector A. M. Lockett & Co., 1627 S. Carrollton Ave., New Orleans.
- W. S. HENNING, (S.), (1919), Land Engineer, Louisiana Highway Commission, Baton Rouge, La.
- RUDOLPH HERPICH, (S.), (1926), Union Brewery, N. O., 3904 Delgado Ave., New Orleans.
- W. T. HESS, (1933), Engineer, Louisiana Power & Light Co., 202 Rosewood Drive, New Orleans.
- OSCAR HIGGINBOTHAM, (S.), (1934), with Compania Ongenios Azaucaveros Mat, S. A. Central Espana, Perico, Cuba.
- ARTHUR M. HILL, (1934), Associate Professor of Heat Engineering, Tulane University, New Orleans.

- GEORGE W. HILL, (1936), Sales Engineering, Westinghouse Electric & Mfg. Co., 2800 Audubon St., New Orleans.
- W. T. HOGG, (1913), Principal Assistant Engineer, Board of Commissioners, Port of New Orleans, 8000 Nelson St., New Orleans.
- JOSEPH A. HALLIDAY, (S.), (1939), Draftsman, Louisiana Highway Commission, Building "C," Pentagon, Baton Rouge, La.
- WALTER HOLLOWAY, (N. R.), (1923), Division Engineer, Mississippi Power Co., Gulfport, Miss., 34 Washington Ave., Ocean Springs, Miss.
- RALPH HOLT, (1938), Manager, New Orleans District, Pittsburg Testing Laboratory, 816 Howard Ave., New Orleans.
- PAUL FROST HOOTS, (1927), Assistant to the President, New Orleans Public Service Inc., 317 Baronne St., New Orleans.
- ALVIN E. HOTARD, (1933), Parish Engineer, Jefferson Parish, City Engineer, City of Gretna, 328 Amelia Ave., Gretna, La.
- S. E. HOTTINGER, JR., Engineer, Examiner Public Works Administration, 38 Allard Blvd., New Orleans.
- J. B. HOWZE, JR., (S.), (1935), Supervisor, W. P. A. Division Operations, 901 Fairview, Shreveport, La.
- JAMES T. HUEY, (S.), (1939), Bridge Designer, Louisiana Highway Commission, 622 Third St., Baton Rouge, La.
- S. E. HUEY, (S.), (1937), Civil Engineer, Monroe, La.
- EDWARD F. HUGHES, (1923), Assistant Engineer, Sewerage and Water Board, 2303 Valmont St., New Orleans.

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- ERNEST LEE JAHNCKE, (L. M.), (Jan. 1, 1900), Jahncke Service, Inc., 814 Howard Ave., New Orleans.
- PAUL F. JAHNCKE, SR., (Jan. 1, 1908), President, Jahncke Service, Inc., 814 Howard Ave., New Orleans.
- JAMES S. JANSSEN, (1933), Civil Engineer, 8213 Neron St., New Orleans.
- A. G. JARREAU, (J.), (1939), Sales Engineer, Fairbanks Morse Co., 18 Fairview Court, New Orleans.
- BEVERLY JOHNSON, (J.), (1939), Engineer, 4553 Gentilly Road, New Orleans.
- FRANK E. JOHNSON, JR., (1937), Assistant to Superintendent Electric Distribution, New Orleans Public Service Inc., 317 Baronne St., New Orleans.
- HAMILTON JOHNSON, (S.), (1937), Professor Mechanical Engineering, Louisiana State University, Box 404, Baton Rouge, La.
- WARREN JOHNSON, (L. M.), (1903), President and General Manager, Johnson Iron Works, Dry Dock and Shipbuilding Company, Inc., P. O. Box 840, New Orleans.
- C. LEONARD JONES, (1923), Structural Designer, with Dock Board, 2747 Audubon St.,
- EARNEST W. JONES, (J.), (1939), Engineer, 3620 Napoleon Ave., New Orleans.
- THOMAS J. JONES, (S.), (1939), Civil Engineer, New Iberia, La.
- CHARLES E. JOUBERT, (L. M.), (Jan. 1, 1909), Civil Engineer, Lafayette, La.

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- F. NOEL KAMMER, (1936), Engineer, Flintkote Co., 1453 Arabella St., New Orleans.
- KARL P. KAMMER, (1931), Efficiency Engineer, Market Street Station, New Orleans Public Service Inc., New Orleans.
- CLAUDE J. KELLY, (1936), Vice-President, New Orleans Cement Products Co., 4139 Gen. Taylor St., New Orleans.
- JAMES P. KEMPER, (H. M.), (L. M.), (May 25, 1909), Civil Engineer in Private Practice, Fardoche, La.
- ARCH B. KENNEDY, (S.), (1939), Road Drafting, Louisiana Highway Commission, 1708 Dolores St., Baton Rouge, La.
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- BERNARD L. KIERNAN, (1939), Chief Engineer, Jackson Brewing Co., 519 S. Scott St., New Orleans.
- E. L. KING, (J.), (1939), Draftsman and Machine Designer, 2120 Audubon St., New Orleans.
- O. G. KIRBY, (S.), (1939), Engineer and Estimator with Robinson & Young, Contractors, 1825 Wisteria St., Baton Rouge, La.
- LEE W. KING, (1936), Civil Engineer, 2107 Broadway, New Orleans.
- LEONARD R. KIRST, (1928), Civil Engineer, with Board of State Engineers, 8122 Birch St., New Orleans.
- JOHN KLORER, (L. M.), (Jan. 23, 1898), Planning and Consulting Engineer, New Orleans Sewerage and Water Board, 526 Carondelet St., New Orleans.
- WILHELM E. KOCH, (1913), Civil Engineer, 2627 Coliseum St., New Orleans.
- R. B. KOHNKE, (1911), Assistant State Engineer, 932 Picheloup Place, New Orleans.
- LOUIS I. KORN, (J.), (1933), Teacher, 6030 Garfield St., New Orleans.
- GUS C. KRAUSS, (L. Aft.), (1929), Assistant Superintendent, Rolling Stock and Shops Dept., New Orleans Public Service Inc., 2838 Iberville St., New Orleans.
- PERCY C. KUHN, (1937), District Sales Manager, Truscon Steel Co., 2121 Octavia St., and 1193 Canal Bank Bldg., New Orleans.
- ROBERT J. KUHN, (1925), Consulting Engineer, Canal Bank Bldg., New Orleans.

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- EDWARD S. LANPHER, (1918), Retired, Lighthouse Engineer, 1204 State St., New Orleans.
- N. E. LANT, (S.), (1937), Bridge Engineer, Louisiana Highway Commission, Baton Rouge, La.
- LEO J. LASSALLE, (S.), (1936), Dean of College of Engineering, Louisiana State University, University, La.
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- H. L. LEHMANN, (S.), (1937), Testing Engineer, Louisiana Highway Commission, Baton Rouge, La.
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- PAUL J. LETZ, (S.), (1938), 203 E. 8th St., Crowley, La.
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- JOHN McINERNEY, (N. R.), (1920), Superintendent Construction World's Fair, New York City, N. Y.
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- MOSES L. RANDOLPH, (S.), (1939), Civil Engineer, Arkansas Natural Gas Corporation, Shreveport, La.
- CHARLES FREDERICK RANTZ, (1924), Refrigerator Engineer, 222 Homer St., Algiers, La.
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 HENRY J. BULTMAN, JR., 2320 Joseph St., New Orleans.
 EDMOND PAUL BUQUET, 838 Broadway St., New Orleans.
 WILLIAM R. BURK, JR., 7831 Plum St., New Orleans.
 S. STEVE CARNEGIE, 7109 Freret St., New Orleans.
 ROBERT D. COSGROVE, 1710 Pine St., New Orleans.
 HOMER LEE DAVIS, 3820 Vincennes Place, New Orleans.
 JAMES T. DWYER, JR., 1537 Pine St., New Orleans.
 LLOYD P. FADRIQUE, 6853 West End Blvd., New Orleans.
 RILEY B. FELL, 2222 Nashville Ave., New Orleans.
 CHARLES L. FISHER, 1014 Aline St., New Orleans.
 S. A. FERGUSON, 7008 Zimple St., New Orleans.
 ANDRE D. GOMEZ, 2516 Joseph St., New Orleans.
 W. R. GULLEY, JR., 5528 Hurst St., New Orleans.
 EARLE R. GURTLER, 624 City Park Ave., New Orleans.
 JAMES E. HARVEY, JR., 1910 Constance St., New Orleans.
 RICHARD A. HERROD, JR., St. Rose, La.
 EDWARD HOGG, 8000 Nelson St., New Orleans.
 LEON KLEIN, JR., 1514 Joseph St., New Orleans.
 DAVID M. KORN, 6030 Garfield St., New Orleans.
 IRWIN M. LAIS, 2855 Ponce de Leon St., New Orleans, La.
 NORMAN J. LANDRY, 5317 St. Charles Ave., New Orleans.
 ROBERT H. LISTER, 502 S. St. Patrick St., New Orleans.
 MAYER MAYER, JR., 3243 University St., Baton Rouge, La.
 NEIL HUGH McLAURIN, JR., 7102 Freret St., New Orleans.
 PHILIP MITCHELL, 7922 Freret St., New Orleans.
 E. LANDRY MURPHY, 1014 Lowerline St., New Orleans.
 S. C. MURPHY, 15 Rosa Park, New Orleans.
 FRANCIS O'CONNOR, 512 St. Peter St., New Orleans.
 F. J. ORY, 312 Millaudon St., New Orleans.
 ARTHUR C. PORTER, 8407 Panola St., New Orleans.
 JOHN E. POTTHARST, JR., 20 Versailles Blvd., New Orleans.
 ROBERT R. PRECHTER, 802 Fern St., New Orleans.
 THOMAS J. RENNIE, 4904 Baronne St., New Orleans.
 HYMAN SAMUELSON, Box 1588, University, La.
 MILLARD P. SNYDER, 496 Audubon St., New Orleans.
 EDWIN J. SONIAT, 2807 Bell St., New Orleans.
 WM. STANDKE, JR., 3203 Chestnut St., New Orleans.
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 IRWIN C. WEIDIG, 4319 Orleans Ave., New Orleans.
 C. O. WEILBAECHER, 2835 Esplanade Ave., New Orleans.
 W. A. WOOD, 621 Broadway St., New Orleans.

SUMMARY

Honorary Members	5
Life Members	25
Local Members	237
State and Non-Resident Members.....	124
Associate Members	2
Affiliate Members	21
Junior Members	73
State and Non-Resident Junior Members.....	24
Student Members	49
Total.....	530

PAST PRESIDENTS

Sidney F. Lewis.....	1898	Ole K. Olsen.....	1919
Thos. L. Raymond.....	1899	John Riess.....	1920
Henry J. Malochee.....	1900	R. S. Manley.....	1921
Frank M. Kerr.....	1901	Donald Derickson.....	1922
Alf. F. Theard.....	1902	J. S. Bareli.....	1923
Alf Raymond.....	1903	James M. Robert.....	1924
J. F. Coleman.....	1904	Marcel Garsaud.....	1925
W. B. Wright.....	1905	Farrar P. Hamilton.....	1926
W. H. Hoffman.....	1906	Edward S. Lanphier.....	1927
G. W. Lawes.....	1907	John L. Porter.....	1928
C. W. Wood.....	1908	Frederick H. Fox.....	1929
J. T. Eastwood.....	1909	James M. Todd.....	1930
W. B. Gregory.....	1910	Frank G. Frost.....	1931
J. C. Haugh.....	1911	Frederick N. Billingsley.....	1932
D. S. Anderson.....	1912	John H. O'Neill.....	1933
A. M. Shaw.....	1913	A. L. Dunlap.....	1934
W. H. Williams.....	1914	Edward S. Bres.....	1935
L. C. Datz.....	1915	Allen S. Hackett.....	1936
Samuel M. Young.....	1916	C. S. Williamson.....	1937
A. T. Dusenbury.....	1917	Bernard H. Grehan.....	1938
John Klorer.....	1918	David W. Godat.....	1939

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Society on October 30, 1939

The meeting was called to order in the Convention Hall of the St. Charles Hotel by Second Vice-President Rhodes.

Approximately 90 attended the meeting.

Mr. Harry Jacobs, Chief of the State Board of Engineers, presented an illustrated paper on "A Suggested Method for Improving the Low Lands in the Vicinity of New Orleans." He was assisted in the presentation by Mr. L. R. Kirst, Civil Engineer with the State Board.

A supplementary discussion by Professor Steinmayer, Head of the Geology Department at Tulane University, covered some of the points from the standpoint of the geologist.

Due to the length of the paper, discussion following was very limited.

Technical Papers Committee Chairman Kuhn suggested that the November meeting be held on November 20, and that a symposium of river conditions be presented at that time. Particularly in mind was the thought of the low river stage and its relation to the drinking water supply for the city. The suggestion as to subject and change of date was voted upon favorably.

The meeting adjourned to the collation.

A. M. HILL, Secretary-Treasurer

Minutes of the Meeting of the Board, December 19, 1939.

The meeting was called to order about 7 p. m. in 422 St. Charles Hotel by President Godat. The following were present also: Barnett, Crump, Rhodes, Stewart, Hill, V. J. Bedell by invitation.

The reading of the minutes was dispensed with.

A letter from the American Engineering Council was read, and the Secretary was directed to answer it.

The action of Mr. J. M. Todd in casting his vote for the A. E. C. representative from this district was confirmed.

Major Bedell's letter of September 28 regarding qualifications of certain applicants for membership was reviewed. Considerable discussion ensued; it was voted to turn the matter over to the new administration without recommendation.

The Board expressed to Major Bedell its appreciation of his interest in the matter of qualifications.

The meeting then adjourned to the regular meeting of the Society.

A. M. HILL, Secretary-Treasurer

Minutes of the Meeting of the Society, December 18, 1939.

The meeting was called to order in the Convention Hall of the St. Charles Hotel by President Godat. About seventy-five members and guests were present.

The minutes of the previous meeting were read and approved.

Chairman Stewart of the Annual Meeting made some announcements concerning the program.

Proceedings of the Louisiana Engineering Society

The Nominating Committee, consisting of Messrs. Billingsley, Frost and Grehan, presented their recommendations as follows:

President.....	W. H. Rhodes
First Vice-President.....	B. S. Nelson
Second Vice-President.....	C. W. Ricker
Secretary-Treasurer.....	A. M. Hill
Director.....	L. J. Lassalle
Director.....	K. P. Kammer

Each Director is to serve two years.

There were no nominations from the floor. It was voted that the report of the Nominating Committee be accepted.

The technical exercises of the evening consisted of a very interesting description of the Gaylord Container Corporation at Bogalusa.

Mr. B. B. Pierce, Assistant Chief Engineer, spoke on "The Explanation of the Sulphate Paper Process." By means of a large chart the various operations were pictured.

"An Explanation of the Tie-In of the Power Plant to the Paper Making Process" was discussed by Mr. E. L. Cowan, Power Plant Engineer.

A rising vote of thanks was tendered the speaker.

The meeting adjourned to the collation.

A. M. HILL, Secretary-Treasurer

ANNUAL REPORTS

REPORT OF THE SECRETARY-TREASURER

Receipts, 1939:

Dues	\$2,733.89
Advertising	427.69
Contributions	18.75
Proceedings Sales	5.85
Income from Investments.....	146.54
Frozen Deposits	191.78
	\$3,524.50

Expenses, 1939:

Proceedings	\$1,078.71
Entertainment and Outing	75.68
Scholarships	165.00
Printing and Postage.....	490.70
Present for President.....	29.49
Library Expenses	62.55
Bond for Secretary-Treasurer.....	10.00
Refreshments	308.51
General Expenses	179.01
Annual Meeting	407.26
American Engineering Council.....	25.00
Salary Secretary-Treasurer	600.00
Porter for 422 St. Charles Hotel.....	28.50
	\$3,460.41

Balance\$ 64.09

Assets:

Cash, Whitney National Bank, Checking Account.....	\$1,794.63
Sixth Dist. Bldg. & Loan Assn. Stock.....	\$ 500.00
Greater New Orleans Homestead Assn. Stock.....	1,208.76
Union Homestead Assn. Stock.....	500.00
Commonwealth Homestead Assn. Stock.....	300.00
Security Bldg. & Loan Assn. Stock.....	500.00
Columbia Bldg. & Loan Assn. Stock.....	289.00
Savings Account, National Bank of Commerce.....	705.84
	\$4,003.60
Total Insured Investments.....	\$4,003.60
Total Available Assets.....	\$4,003.60
Frozen Funds, Canal Bank, Book Value.....	\$ 302.77
Frozen Funds, Interstate Bank	2,301.37
	\$2,604.14
Total of All Assets.....	\$8,402.37

Members elected during 1939, 109, including student members. Total names on membership list, December 1, 1939, 530. During the year about 12,000 pieces of mail were sent out by the Secretary-Treasurer.

Submitted by

A. M. HILL, Secretary-Treasurer.

REPORT OF THE PRESIDENT OF THE LOUISIANA ENGINEERING SOCIETY FOR THE YEAR 1939.

Gentlemen, this meeting brings to conclusion a most eventful and successful year for the Louisiana Engineering Society. During the past twelve months the Society has grown in membership, influence, and prestige. This growth has been due to the untiring effort of the members of the Board of Direction, the Chairman and Personnel of the various committees and to the stimulating interest of the membership in Society activities.

The year had a most gratifying start when the Society conducted its annual two-day meeting concurrently, with the Spring Meeting of the American Society of Mechanical Engineers, who met here on February 23rd through the 25th. The joint attendance at this meeting was 768, of which it was estimated that nearly 500 were members of the Louisiana Engineering Society. Although the technical programs of the two societies were held separately, many of the social features were held jointly to the mutual enjoyment of the membership of each society. I should like to take this occasion to thank our various committees and the membership at large for the splendid manner in which they contributed towards making the convention a success, particularly, for the generous hospitality which you showed to the members of the American Society of Mechanical Engineers, and our out-of-town guests.

The outstanding event of the past year was the expansion of the Society and the formation of the Baton Rouge Section. For many years it has been the dream of the officers and membership of this society to become statewide in the scope of its activities, and in its influence upon the engineers living in the various communities outside of the New Orleans area.

Aside, however, from their constant efforts to obtain the membership of engineers living outside of New Orleans, little was done towards organizing these so-called "NonResident Members" until 1935. During that year Col. Ed Bres, then President, selected and appointed in each Congressional District of Louisiana, a member to act as a District Contact Representative, or a *laisson officer* between the membership in his district and the Board of Direction. Following this forward looking move each succeeding administration has exerted its best efforts towards increasing the out-of-city membership, particularly efforts being made in communities where large groups of engineers are residents.

The membership living in and about Baton Rouge responded splendidly to such a move, and as a result of their stimulated interest, President Grehan last year appointed a committee to work out a plan for the formation of a Baton Rouge Section. This committee comprising Mr. W. H. Rhodes, Chairman, Prof. B. W. Pegues, and Mr. B. Dornblatt, were reappointed by your president to continue their work.

Guided by the reports of this committee, and by the personal efforts of Dean LaSalle, Prof. Pegues, Mr. N. E. Lant, Mr. Chas. A. Meyers, all of Baton Rouge, the Board of Direction was able to work out the necessary arrangements for the formation of a Section of the Society at Baton Rouge. To accomplish this purpose, both the Constitution and the By-Laws of the Society had to be amended, the first to enable the Society to establish Sections wherever deemed advantageous ;and the latter to establish regulations governing the formation of such sections.

The Baton Rouge Section was organized under these regulations with 44 members, and held its first meeting as a unit of the Society, on December 6th, 1939. The area of this Section embraces the parishes of

East and West Baton Rouge, East and West Feliciana, Iberville and Pointe Coupee.

At the beginning of the current year there were 451 active paying members in the Society. This number was only made possible by the splendid work of Mr. Grehan and his membership committee. Mr. Grehan's record of 100 new members of last year at first seemed an almost unattainable goal. It reacted however as a direct challenge not only to the Board but to the membership committee. As a result, I am happy to say that this committee, ably headed by Mr. Rhodes, has this year exceeded that record by nine members. A large part of the credit for this accomplishment likewise is due to the industry of the Baton Rouge membership, notably Prof. Pegues, Mr. Lant, and Mr. Charles A. Meyers. This group brought in 32 new members in that section.

Inasmuch as the Society lost through resignation and deaths last year 30 members, our total membership now stands at 530.

During the year six members who had paid dues over a period of thirty years automatically become Life Members. These gentlemen are:

WADE BARNETT
GEORGE H. DAVIS
ALLAN T. DUSENBURY
CHARLES E. JOUBERT
JAMES P. KEMPER
JOHN L. PORTER

In 1939 twelve meetings were held, eleven in New Orleans and one in Baton Rouge. The Baton Rouge meeting was, and has always been, a most interesting and delightful affair, and was preceded, as usual, by a supper tendered the Society by the Louisiana State University.

In the past it has been the policy of the Society to adjourn during the summer months of July and August, reconvening again in September. This year your President, feeling that much of the fellowship and interest derived from monthly meetings was being lost through the summer recess, placed the matter before the membership. The Society voting in the affirmative, interesting and well attended meetings were held during July and August.

In addition to the regular meeting of November, an extra meeting was held at the instigation of the Association of Commerce. The purpose of this meeting was to enable the Association to enjoy the benefit of engineering opinion, through the discussion of Chief State Engineer Harry Jacobs plan to improve the lowlands adjacent to New Orleans.

This request on the part of the Association of Commerce for our aid in a civic project is indeed a tribute to the growing prestige of the Society. It is hoped that the Society will not only continue to welcome such cooperative opportunities but will, wherever possible, endeavor to participate in civic undertakings which may concern the engineer and his profession.

I should like to commend here Mr. Robert Kuhn and the members of his committee for the high quality of the Technical papers which they offered the membership throughout the year. Upon this committee depends to a marked degree the success or failure of the meetings, and in turn the interest of the membership in the Society. The excellent attendance at these meetings therefore speaks well for the quality of the technical program presented.

On June 15th the Society held its annual Golf Tournament and Smoker at the Colonial Country Club. Ninety members and guests par-

tiipated in the Golf Tournament and the Horse-shoe Pitching Contest, while 81 attended the Buffet Supper and remained to enjoy a good floor show. Mr. Jimmie Bulliung and his committee are to be complimented for their handling of this affair, which cost the Society only \$76.58.

Financially the Society weathered the year in very fair shape. Secretary-Treasurer Arthur Hill advises that our actual income during 1939 amounted to \$3,525.00, or only \$15.00 less than that estimated at the beginning of the year by Finance Chairman Carroll Pierce.

Although the expenditures for the year, amounting to \$3,460.41, exceeded our budget by \$155.41, there still remains an unexpended balance of \$64.50 out of the revenues derived during the year. When it is considered that two additional meetings were held with their incident expense for collation, etc., this balance is very gratifying. We are indebted to our Secretary-Treasurer, Mr. Hill, and Finance Chairman, Mr. Peirce, for their judicious management of the Society's funds.

Mr. R. H. Baumbach, Chairman of the Employment Committee, reports that he has placed 27 men in positions during 1939 from applications filed with the committee. (There were 34 vacancies listed with him and 109 applicants for jobs).

One of the objects of this Society as expressed in our Constitution is "the encouragement of social intercourse among engineers and men of practical science." To the Woman's Auxiliary of the Louisiana Engineering Society should go a large measure of the credit for the successful accomplishment of this aim. The Auxiliary through their parties, and through their participation in our social functions, has brought about a closer personal bond between the members of this Society.

It is with pleasure too that I note that the Auxiliary will serve coffee at Dixon Hall tonight after Mr. Wheelwright's address. Those of you who attended General Wesson's address last year will recall with pleasure the social hour spent with them on that occasion.

Aside from their social activities, however, I am advised that the Auxiliary is accumulating a fund to establish an Engineering Fellowship for graduate study from the proceeds of their St. Patrick's Day parties. In this, the Woman's Auxiliary should not only be praised for this worth while aim, but should enjoy the wholehearted co-operation of our membership in attaining their goal.

In reviewing the year in retrospect we can hardly comment upon the annual meeting now being held. We can and should, however, give recognition to General Chairman Dave Stewart and his committee on the excellent program which they have arranged for us. This program speaks for itself.

To all committees and particularly to the members of the Board of Direction, I wish to express my sincere appreciation not only for the work which they have done, but for the co-operation and encouragement which they have shown me during my administration.

I wish also to thank the membership for their interest in the affairs of the Society during this year and to assure you that I am deeply grateful for the honor of having been your President.

DAVID W. GODAT, President.

ACTIVITIES OF LOCAL SECTIONS

President,
N. E. LANT

1st Vice-President,
J. A. McNIVEN

2nd Vice-President,
F. N. BILLINGSLEY

Secretary-Treasurer,
V. J. BEDELL



STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

Special Meetings at
call of President

A meeting of the Section was held in connection with the Annual Meeting of the Louisiana Engineering Society at the St. Charles Hotel, New Orleans, on January 12 and 13, 1940.

At this time papers were read by Mr. A. J. Boase, Manager Structural Bureau, Portland Cement Association, Chicago, on "European Practice in Reinforced Concrete Structures" and by Lt.-Col. Wm. F. Tompkins, District Engineer, 2d. New Orleans District, U. S. Engineers, on "The Wax Lake Outlet and the Charenton Drainage and Navigation Canal." Both papers were illustrated by lantern slides and proved of extreme interest to the members present.

On February 9, 1940, the Annual Meeting of the Section was held at the residence of Mr. Ole K. Olsen in New Orleans. As usual this meeting was the climax of the year's activities, and taxed the Rathskeller of Ole's to capacity.

Preceding a paper on the "The LeMieux Tritometer Method for Pile Testing" by Mr. M. M. Gurtler, II, Vice-President and Chief Engineer of Substrata Engineers, Inc., New Orleans, was the election of officers for the present year.

The officers elected to lead the Section during 1940 were:

Mr. N. E. Lant, Baton Rouge.....	President
Mr. J. A. McNiven, New Orleans.....	1st. Vice-President
Mr. F. N. Billingsley, New Orleans.....	2d. Vice-President
Mr. V. J. Bedell, New Orleans.....	Secretary-Treasurer

Announcement was also made by Col. E. S. Bres, Chairman Scholarship Committee, of the award of scholarships to the following Seniors: Mr. Walter F. Blessey, Tulane University, and Mr. O. H. Green, Louisiana State University. Awards for the two Junior Memberships in the American Society of Civil Engineers will be announced later.

After a lively discussion it was voted to continue publication of the LASEC NEWS, and a committee will be appointed to determine the future policy regarding its publication.

A committee will also be appointed to revise the By-Laws of the Section as there is only one copy of the present By-Laws in existence.

Following the business session and the paper by Mr. Gurtler the Section adjourned for a fellowship meeting and get-together in the Rathskeller.

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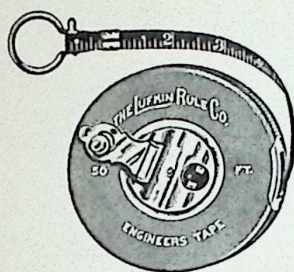
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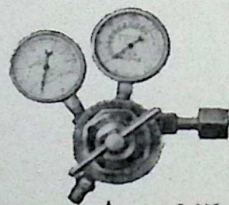
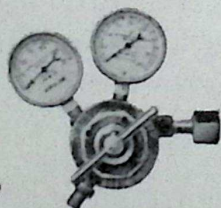
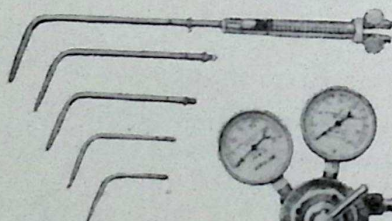
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JAMES M. ROBERT, Editor.

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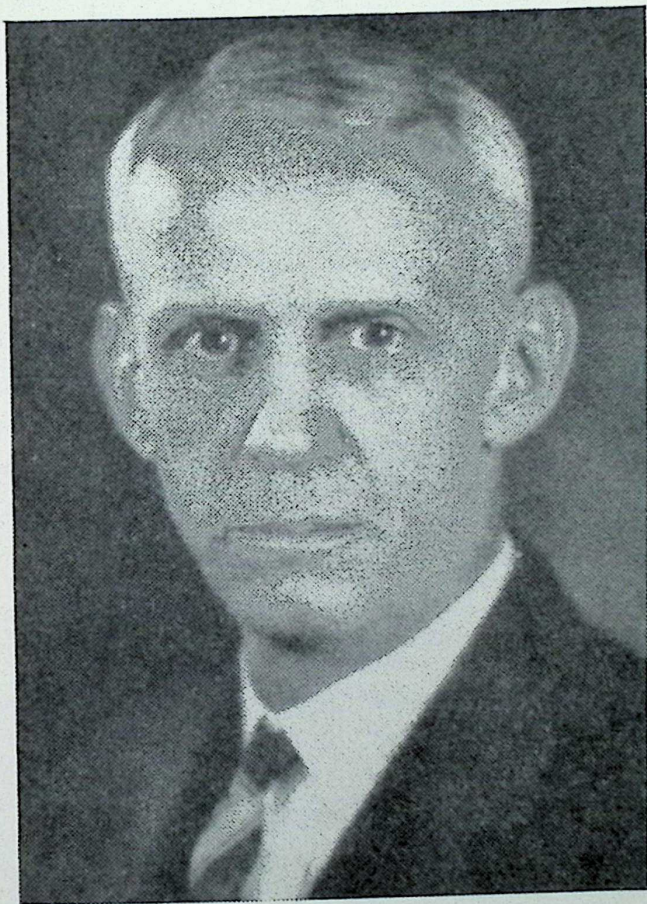
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The last name on each committee is the Junior member, who sits with the committee, but without vote.



PROFESSOR B. W. PEGUES, President
Baton Rouge Section, Louisiana Engineering Society

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

VOL. XXVI.

APRIL, 1940

No. 2

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EDITORIAL NOTES AND COMMENT

The President of the Baton Rouge Section. The first president of the newly formed Baton Rouge Section is Professor Boykin W. Pegues, a native of DeSoto Parish, Louisiana. In 1892 he entered Louisiana State University, from which he graduated in 1895 with a degree of B. S. in Civil Engineering.

From 1895 to 1898 Prof. Pegues was engaged in making topographical surveys for river improvement in Louisiana and Alabama. The surveys were made under the direction of the U. S. Government.

In 1899 he was appointed Assistant Professor of Civil Engineering at Louisiana State University. From 1901 to 1927 he was Professor of Civil Engineering at L. S. U. From 1927 to

1930 he served as Acting Dean of the College of Engineering, L. S. U. From 1930 to date he has been Head of the Department of Civil Engineering at L. S. U.

He received his Master of Science degree from the University of Wisconsin in 1928.

From 1908 to 1936 Professor Pegues served as a member of the Louisiana State Board of Engineering Examiners. He is a life member of the Louisiana Engineering Society; member of the American Society of Civil Engineers; member of the Society for the Promotion of Engineering Education, and a member of Phi Kappa Phi and Tau Beta Pi, honorary fraternities.

Baton Rouge Section Committees. For the information of the membership at large, the committees which have been appointed for the Baton Rouge Section are as follows:

Membership: W. W. Tennant, Chairman, 520 Convention street; E. H. Swick, 341 East Boulevard; E. C. Coburn, 2175 Wisteria; H. L. Lehmann, Testing Laboratory, Hwy. Comm.; Stanford Rayne, Box No. 111, Istrouma.

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

Bohne, William H. Junior Member. Age 24. Endorsed by Donald Derickson, H. E. Crump, M. M. Gurtler. Graduate of Tulane University. Civil Engineering 1½ years, La. Hwy. Comm.; 8 months, Caldwell Bros. & Hart; 3½ months, draftsman, Dock Board. 1217 Napoleon Ave., New Orleans.

David, Thomas C. State Member. Age 26. Endorsed by C. A. Ives, Jr., N. E. Lant, H. B. Henderlite. B. S. in Civil Engineering, University of Notre Dame, 3 months rodman, 3 months levee const., 5 months rodman on hydrographic surveys and dredging operations, all with U. S. Engineers; 2 years as construction engineer for levee contractor; 2 years 11 months as party chief and draftsman on highway planning and research with La. Hwy Comm. Louisiana Highway Commission, Baton Rouge.

Dodge, Farrar R. State Junior Member. Age 24. Endorsed by J. M. Robert, C. S. Williamson, A. M. Hill. Graduate of Tulane June, 1937, B. E. in Chem. Eng. 1937-39 as bench chemist with Fellsmere Sugar Producers Association, Fellsmere, Fla. Presently employed as Asst. Engineering Aid, U. S. Eng. Dept. 2nd Area, Baton Rouge. 302 St. Louis Street, Baton Rouge.

Downs, Fletcher G. State Member. Age 54. Endorsed by P. L. Morris, S. L. Hebrard, C. A. Myers. Graduate of Columbia University, A. B. and E. M. degrees. Summary of experience: Wide variety of civil engineering and mining work since graduation. 2068 Myrtledale Avenue, Baton Rouge.

Dupree, S. G. State Member. Age 35. Endorsed by B.W. Pegues, C. A. Ives, Jr., F. F. Pillet. Instrumentman on location and construction, La. Hwy. Comm.; 3 years Resident Engineer, La. Hwy. Comm.; 2 years Senior Draftsman and squad leader, La. Hwy. Comm.; 5 years private surveying. B. S. degree Louisiana State University. Registered Civil Engineer; candidate for M. S. in Engineering, L. S. U. 975 Government Street, Baton Rouge.

Knight, John T. Member. Age 45. Endorsed by Neville Levy, W. U. Moss, W. P. Oster. Graduate U. S. M. A. 1917, B. S.

degree. Works Mgr. Joliet Roadway Supply Co. About 3 years Mgr. Balabaw & Katz Corp. Total about 9 years. Chief engineer, Paramount Pictures Corp in charge of theaters about 6 years. President and chief engineer Safety Service Milk Bottle Corp., developing automatic machinery for manufacture of paper bottles 2 years. Present establishing office in New Orleans as a consultant specializing in theater engineering, air conditioning, etc. 608 Canal Street, New Orleans.

May, George Elmer. Member. Age 37. Endorsed by F. G. Frost, Paul F. Hoots, Karl P. Kammer. Graduate Tulane University, B. E. in M. & E., 1926. Draftsman New Orleans Public Service 2 months. Engineer, Independent Aetna Sprinkler Corporation, 8-15-26 to 10-1-28. Sales engineer, New Orleans Public Service Inc. 11-15-28 to 10-1-34. Engineer, New Orleans Public Service Inc., 10-1-34 to date. 2031 Short Street, New Orleans.

Mullin, Thomas Joseph, Jr. Junior. Age 29. Endorsed by C. G. Muench, L. DeVall, J. Norman Wilson. Rodman and chainman on surveys during 2 summer vacations. I year University of Notre Dame. 1 year draftsman and construction inspection on Mississippi River Bridge, N. O. Siems, Helmers, Inc., Pier Contractors 3 years. At present in the engineering department Celotex Corp. in responsible charge of construction in assistance to chief engineer. Box 26, Marrero, La.

Patterson, Harold J. Member. Age 50. Endorsed by A. M. Fromherz, F. G. Frost, James M. Todd. 1926 to date, general contractor, New Orleans. 1923-26 Resident Engineer and Purch. agent Phoenix Utility Co. 1922-23 Construction superintendent for Knickerbocker Ice Co., New York City. 1917-22, field engineer, Foundation Co., New York City. Also general foreman, const. engineer, const. supt. 1911-17 General engineering work. 1907-1911 Cornell University; degree of C. E. in 1911. 5216 Danneel Street, New Orleans.

Polhamus, Royal S. Member. Age 60. Endorsed by J. P. Henderson, B. S. Nelson, C. C. Crawford. 15 years Am. Bridge Co., draftsman, checker, designer. 5 years McClintie Marshall Co. 3 years Dominion Bridge Co., resident engineer. 3 years

Mobile Ship Building Co., Naval Arch. 8 months So. Adv. Bag & Paper Co., chief engineer. 8419 So. Claiborne Avenue.

Rayne, Stanford, Sr. State Member. Age 46. Endorsed by W. W. Tennant, B. W. Pegues, C. A. Myers. With Standard Oil Company of Louisiana for the past 21 years or since graduation and discharge from the army in 1919; department foreman in the mechanical department. R. F. D. No. 4, Baton Rouge, La.

Roaten, William S. State Member. Age 35. Endorsed by R. P. Lockett, B. S. Nelson, F. G. Gault. Engineering graduate La. Tech., Class 1925. Draftsman Standard Oil Co., Shreveport 1925. Const. work, Ford, Bacon & Davis, 1926-27. Erecting Supt. Worthington Pump & Mach. Corp., Buffalo, N. Y., since 1928. Worthington Pump & Machinery Corp., Buffalo.

Terry, L. M. State Member. Age 37. Endorsed by H. B. Henderlite, C. A. Myers, J. P. McCullough. Sixteen years with the La. Hwy. Comm. as instrumentman, resident engineer, draftsman. La Hwy. Comm., Baton Rouge.

Tompkins, William F. Member. Age 47. Endorsed by V. J. Bedell, Donald Derickson, C. S. Williamson. Graduate U. S. Military Academy 1915; Engineer School, Washington, 1917; Command and General Staff School 1929, Army War College 1932. First Lieut. 2nd. Engineers on road construction in Mexico; Sept. 1916-Jan. 1917. Searchlight duty in France; Dist. Engineer, Savannah, Ga. Commanding officer 8th Eng. at Fort McIntosh, Texas. Member War Dept. General Staff 1932-35. Consulting engineer and chief regional engineer W. P. A., October 1935-May 1936. Lt. Col. C. E. Dist. Engineer 2nd N. O. district. June 1936-date. 5341 St. Charles Avenue, New Orleans.

Re-Instatement

Fourmy, James M. Civil Engineer. Consulting Engineer. Hammond, La.

Society Scholarship 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 until 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 James M. Robert, Dean of Engineering, Tulane University, New Orleans.

Papers in This Issue. This issue of the *Proceedings* contains two papers, each by an authority in his field.

Col. Shaw's paper on River Delta Formation gives the results of his thought and wide experience in work of this type. This experience has been gained both at home and abroad.

The paper by Mr. E. L. Durkee of the Bethlehem Steel Company is one which is both interesting and instructive, since it is a description of the progress of one of the big engineering works of the country. It was read before the Louisiana Section of the American Society of Civil Engineers in Baton Rouge.

PAPERS AND DISCUSSIONS

RIVER DELTA FORMATION*

By COL. ARTHUR M. SHAW *

There are certain features which are common to all river-delta regions and others which are of prime importance in some but are almost or entirely absent in others. This paper will be mainly concerned with methods of deposit, occurrence in the deltas discussed of varying materials and some of the characteristics of these deposits.

An inexcusable disregard of our local soil conditions has undoubtedly caused a loss of countless thousands to the tax payers and home owners of New Orleans through the excessive—and more important—the unequal settlement of what might be classed as minor structures.

Foreign Rivers

To get a more comprehensive view of the subject, we will first consider a few delta-forming rivers in other countries with which I have had some direct contact.

In Central and Northern China, all the major streams flow in an easterly direction. Beginning with the most northerly, these are the Pei Ho, the Huang Ho, the Hwai Ho, the Yangtse Kiang and the Chien Tang Kiang. In connection with this nomenclature it may be of interest to note that the Chinese words "Ho" and "Kiang" are exact equivalents of our word "river."

The Pei Ho watershed is of limited area but with its tributaries, it is of interest because of the difficulties in the control of its floods, its effect on the plains adjacent to the former capital (Pekin) and especially the complications which its floods and loads of silt present in the maintenance of the Port of Tientsin on the Gulf of Chihili. Its general characteristics are similar to those of streams of equal size on this continent.

* Member, Louisiana Engineering Society. Presented before the Society on February 12, 1940.

Next below the Pei Ho is the Huang Ho or, literally translated, the Yellow River. In area of catchment basin, length, volume of flood discharge and area of delta cone, this is one of the great rivers of the world but as a bearer of commerce, its importance is almost negligible. Failure to utilize the stream is mainly due to the erratic nature of its channel, caused by the peculiar character of silt carried. For a large portion of its course, the Yellow River flows through a loess country, the material being inpalpably fine and most readily eroded. The only other deposits of similar material of which I have knowledge are found in the bluffs in the vicinity of Vicksburg and along the Missouri River from Kansas City to beyond Sioux City, though the hills around Ripley, Tenn. also appear to present similar characteristics. To illustrate how easily such material is eroded, I was engaged in some bank protection work on the Missouri River near Omaha a number of years ago. Preliminary to placing mats and rip rap, several piles were driven in shallow water with a penetration of nearly 20 feet. The current was quite strong at this point and the obstruction formed by the piles created an eddy which seemed actually to ream out a large hole around each pile. Within a few hours, they were all on their way floating down the river.

The critical velocity below which transported loess will be deposited is definite. Unlike rivers which transport a mixed cargo, the Yellow River does no sorting as its velocity decreases. It simply dumps practically its entire load, choking its own channel and then breaking over the artificial and natural levees and flooding from a few thousand to several millions of acres and even occasionally destroying walled cities.

This statement regarding uniformity of transported material is not entirely true for in its southerly course, between the Province of Shansi and Shensi, the Yellow River flows through a mountainous country, with many gorges and some falls of considerable magnitude. Sand and gravel accumulated along the steep gradients are deposited before much of the loess load is lost.

The delta of the Yellow River has a base width (on an air line) of 520 miles, extending from the mouth of the Yangtse River to Tientsin. From the coast to the apex of the cone above Kaifeng is nearly 400 miles. During historic times the Yellow River has discharged into the sea at various intermediate points and at one time or another has flooded the entire area above outlined, excepting only a limited section of mountainous lands in the Shantung peninsula. It is much as though the Mississippi River, with the apex of its delta cone a little below Memphis, had changed its course from time to time, to discharge into the Gulf at various points along the coast from the Sabine River to Pensacola, flooding at one time or another all of the inclosed triangle excepting a mountainous area comprising a few of the parishes in the vicinity of Bayous Lafourche and Terrebonne.

In 1887 the Yellow River broke out and followed a southeasterly course, discharging some of its flood directly into the Yangtse River. It now discharges into the Gulf of Chihili, more than 400 miles to the north.

Except for the years 1887 to 1889, and a few other short-time migrations, the river has kept to its present northeasterly course since 1852, this course being practically identical with that of the 13th century.

In his account of the "Floods of the Yellow River" (A. S. C. E. Transactions—Volume 85) John R. Freeman gives a map showing the various routes followed by the Yellow River. This map was compiled from such Chinese sources as were available. The earliest records indicate the location of the river channel in the year 2278 B. C. That illustrates one of the many attractive features of engineering studies in China.

South of the Yellow River is one of secondary importance, the Hwai Ho. The conduct of this stream was almost exemplary until the usurpation and destruction of its route to the sea by the Yellow River during several years prior to 1852. With its early outlet entirely blocked off by loess deposits, the Hwai River now has no alternative but to discharge its flood

waters into the various lakes and marshes lying north of the Yangtse, into the Grand Canal, over the agricultural lands of the fertile areas along its course and even occasionally into the Yangtse itself. Its floods may now cause the loss of thousands of lives and untold damage to both the farming lands and cities.

Next to the south is the Yangtse River, the one stream of China which, in its general characteristics, is most nearly like our own Mississippi. One main difference however is that many of the lakes of the Yangtse Delta, corresponding to our Lakes Pontchartrain and Salvador, are found much farther up the course of the river, the largest of these, Tai Ting Hu being above Hankow, nearly 600 miles (in an air line) from the sea. These lakes, if they happen to be at a low stage during floods in the Yangtse, tend to reduce the flood peak and it is probable that works will eventually be constructed to utilize the larger lakes as controlled detention reservoirs for flood protection.

South of the Yangtse is the Chien Tang River with its principal tributary, the Pu Yang, entering the main stream near the apex of their joint delta cone. The delta of the Chien Tang is of interest mainly because it borders and is affected by the tides of Hanchow Bay. The initial tidal wave which enters the bay often exceeds six feet in height. This is followed closely by other distinct waves, all of which result in a total rise of tide of more than twenty feet. Until the construction of the Hangchow sea wall several hundred years ago, the tidal bore, combined with flashy floods from the Chien Tang and Pu Yang Rivers, resulted in frequent and radical changes in the shore line of the estuary. A copy of an old map which was furnished for my use in the re-design of a section of the sea wall showed the location of what had been an important market town. The site shown is now nearly twelve miles out at sea.

Each delta cone described in the foregoing overlaps that of the next adjacent river and deposits from the Yellow River have encroached on all of them except the most southerly. It

is doubtful if such a condition, involving two major rivers and three that are classed as secondary (but still of substantial importance) can be found anywhere else.

In the deltas of the Yangtse and the Chien Tang Rivers, conditions affecting foundations are quite similar to those encountered in the vicinity of New Orleans though so far as I was able to ascertain, there do not exist evidences of the many oscillations of surface level as have occurred in this area. As might be expected, the soils of the lower Yangtse delta are composed of only the finer transported materials though apparently due to a higher sand content, it is more easily eroded than the Sharkey Clay of the lower Mississippi.

About the year 1400 A. D., a flood of the Yangtse destroyed an entire walled city, the site of which is now occupied by a circular lake covering approximately two square miles. The loess soil of the Yellow River delta is quite uniform. Within suitable limits, and in the absence of moving water, it carries spread footings satisfactorily.

Except along the edges of some of the fresh-water lakes of the Yangtse delta, I have never seen evidences of layers of decayed vegetation corresponding to the deep layers of muck of our trembling prairies.

With the exception of the Chien Tang River, which I have traversed for its entire length, my own observation of Chinese river deltas has been confined to regions not more than about one hundred miles from the coast. In these areas, the aspect is far different from our Louisiana marshes. The land is cultivated intensively but there are few buildings to obstruct the view, as most of the farmers live in villages and towns. There are practically no trees except the mulberry orchards grown to feed the silk worms, and perhaps a grove surrounding a monastery. One striking variation is the occasional hill or small mountain rising abruptly out of the plain. From their position and apparently volcanic origin, it is my theory that before the deltas were formed, these hills and mountains were a continuation of the system of small islands comprising the

Chusan Archipelago, which lies off the coast of South-Central China.

There is one feature of the eastern coast of China which is markedly different from our sea frontage and which doubtless has a substantial influence on the rate of growth seaward of all the Chinese deltas and this, in turn, may have affected the character of soils comprised in each delta. For many miles out from the China shore, the Gulf of Chihili and the Yellow Sea average only about forty feet deep, while the Mississippi River is handicapped in its continent-building efforts by a sea depth of six hundred feet.

The Magdalena River

Jumping now to South America, the delta of the Magdalena River presents problems in drainage and foundations quite similar to ours, though some of the planters in the delta (but adjacent to the hill lands) have special difficulties of their own. One large sugar plantation, for which I made preliminary drainage plans several years ago, is frequently flooded by small streams coming down from the adjacent hills. The design of works for protection against water would have been quite simple were it not for the complication of sand, gravel and rocks which came along with the water. On entering the low-gradient streams of the delta such detritus was dropped and the trouble started. No satisfactory method has yet been found for overcoming the difficulty.

The cities of Barranquilla and Cartagena are in this delta and Santa Marta is at the eastern fringe. Barranquilla is on the bank of the main river, ten or twelve miles above the mouth. At this point a New Orleans visitor might feel quite at home owing to the many old Mississippi River stern-wheel steam boats tied up to the bank. I had often wondered what had become of all our river boats until my visit to Barranquilla.

Cartagena is probably the only walled city on the American Continent. It was designed for the safe deposit of the riches gathered by the early Spanish conquistadores and resisted all attacks of the English buccaneers. Morgan did gain

an entrance by treachery at one time but with no substantial gain.

On the low-lying areas of the Magdalena delta, just west of Santa Marta, many acres have been improved, creating great salt pans for the manufacture of salt by evaporation of sea water. The same industry is carried on, on a much larger scale, along the shores of the estuary of the Chien Tang River in China.

Lower Mississippi River Delta

In the following material concerning our own particular area, no effort has been made to present in logical sequence the various features discussed, the purpose being to record some of my own observations made and impressions gathered during the years engaged in work in this locality.

The topography of this area has been influenced not only by over flow of the main river but also by the action of its many branch outlets, the most of which are now shut off from the main stream, some by natural processes and some by works of man. Among the latter are Bayous Lafourche and Plaquemine. Bayou Terre au Boeuf in St. Bernard Parish and Metairie, in Jefferson and Orleans Parishes, apparently had not been silted up at the river junction very long before New Orleans was settled. As a matter of fact, but with documentary evidence to support this idea, conditions at Poydras as late as 1909 seemed to indicate that Bayou Terre au Boeuf may have served normally as a natural outlet within historic times.

It is characteristic of the main river and its principal outlets to build ridges or natural levees along each bank, those along the main river extending back for a mile or more from the stream. In this locality, the lands so built are ordinarily ten to fourteen feet above gulf level and feather down nearly to gulf level at the prairies. Generally speaking, there originally was a heavy timber growth on lands that were one or two feet or more above gulf level. Conditions along the more important bayou outlets are similar but on a smaller scale. On Bayou Lafourche, the overflow-built lands taper down to the

swamps at a distance of about half a mile. There are important variations in the width of high land bordering both the river and the bayous however. At some locations, flood flows through breaks in the natural (or later, through artificial) levees have continued to run for an entire season or more, building up comparatively high land at a considerable distance from the main stream. In 1902, before it was cut off at Donaldsonville, Bayou Lafourche nearly destroyed the Matthews plantation but the silt deposited so enriched the soil and increased the area of cultivable land that the net result may have been to the advantage of the owner.

Not all bayous of this section show the above characteristics. Some are merely tidal connections between bodies of comparatively clear water and, during their life history have only at infrequent intervals carried heavy loads of silt. Wax Bayou, tributary to the lower Atchafalaya, and Bayou Villar, connecting Lake Salvador with Bayou Barataria are examples of such.

Metairie Bayou, Gentilly Bayou, Bayou Sauvage, and Bayou St. John

One of the most interesting of the pre-historic outlets of the Mississippi is the one which left the river at a point below Kenner and followed a generally easterly course, not far south of the south shore of Lake Pontchartrain. It is my theory, and that of many others, that what became known as Bayou Metairie, Bayou Gentilly (or Chantilly as it appears on some old maps) and Bayou Sauvage were originally one continuous outlet from the river to tidewater. Surface conditions also support the theory that at one time there was a fresh-water lake covering a considerable portion of what is now the down-town section of New Orleans. This apparently overflowed, due to additional water from the river, breaking through the bayou ridge at a point near the present Esplanade Avenue bridge and forming what we know as Bayou St. John. This stream never could have served for any length of time as an outlet of the river as its banks were not built up to any considerable height. It did play an important part however in the development of the young colony established at its head as shallow-draft boats,

crossing Lake Pontchartrain, could come to the back door of the settlement. An old map of the early 1700's shows a water-power mill, not far back from the river and a little below Esplanade Avenue, with its tailrace discharging into Bayou St. John.

It seems quite possible that the Metairie-Gentilly-Sauvage outlet continued during its early life to an outlet in the Rigolets, building the ridge which is followed by the highway to Ft. Pike. If such were the case, then the Chef Menteur Pass must also be of more recent origin.

Excavations made at various points along the Metairie-Gentilly Ridge indicate that it did not enjoy an unbroken period of upbuilding. Submerged stumps in situ, logs and other materials, all indicate recurring cycles of building up by silt deposits, forest growth, subsidence with encroachment of salt water and killing of trees and then another period of building up. In 1916 to 1917, a pumping plant was built along the left bank of the 17th Street Canal (which follows the Jefferson-Orleans Parish Line) nearly a mile north of the Metairie Ridge. In the excavation for this plant, three distinct strata of forest were encountered, one at the surface (which was only slightly above Gulf level) another about six feet down and a third about 12 feet below the surface. The position of the stumps, with roots intact, preclude any idea of their having drifted in, though other material encountered at considerable depth undoubtedly could be classed as drift. While evidences of a third stratum of cypress stumps are comparatively rare, a considerable portion of the Hanson Canal (near Franklin) was excavated through such a formation. On being questioned as to the amount of explosives required for the work, the contractor replied: "Oh, I don't remember much about it but I do remember that about every time I ordered a car of coal for the dredge, I ordered a car of dynamite for the clearing gang."

The roots and even the quite solid stumps of the lowest of three forest growths deteriorate rapidly on exposure to the air but chips cut from stumps of the intermediate stratum retain their form and strength after several months of exposure.

In exploring a large trace of land lying to the north of Bayou Penchant, in the lower Atchafalaya basin, thirty or forty test holes were put down to a depth of ten feet except where obstructed by submerged timber, and this occurred at more than half the holes. This was in a fairly firm grass-covered prairie with timber in sight only on the horizon, certainly five miles away.

In the vicinity of Littlewoods, and farther east, in the Michand Tract, it is apparent that the surface is gradually subsiding. To the north of Michand Station, an arm of what obviously was once higher ground, branches off from the main ridge to the north. A considerable stand of dead trees may be seen along this spur, which has sunk too low for the continued growth of gum and cypress.

Bayou Metairie has become nearly obliterated by recent improvements though traces of it may still be seen at several points along Metairie Road and the lagoon in Metairie Cemetery is a part of the original bayou. Similar conditions exist along Bayou Gentilly from Bayou St. John to the main line of the Southern Railway, but from the latter point easterly, it can be traced for the most of its original course. For several miles of the eastern portion of this bayou, which is known as Bayou Sauvage, it has a depth of four to ten feet, shoaling to a foot or two at its outlet at Chef Menteur.

One of our fellow members, John Riess, has gone farther down with an open excavation in the Metairie section than anyone else of whom I have been able to learn. In his excavation for the main building of the new sewage treating plant at Demosthenes Street and Bonnabel Canal he excavated the pump pit practically to Cairo Datum or about 19 feet below present ground level. This location is nearly a mile north of Metairie Road and one and one-quarter miles west of the Jefferson-Orleans Parish Line. A considerable portion of the deep excavation was in a miren beach formation of white sand with shells of varying sizes scattered through the sand. Some of the shells were larger than a man's hand. This old sea beach appears to have run in a southeasterly direction where it was encountered

in several of the excavations for sewers which are being put in by the Drainage Construction Company. At Focis Street, which comes into Metairie Road just west of the Frisco tracks, sand was encountered at a depth of about 12 feet only two blocks north of Metairie Road and at a depth of less than four feet at Canal Street, about half a mile north of the main road.

The most of my own experience in the Lower Delta has been with shallower excavations but even in these, surprising variations in depth of strata and character of material are found where there is no surface indication of a change though a close observer may be able to detect signs that others would miss. A slight change in the vegetation in an apparently dead-level prairie indicates a change in the surface or near-surface soil. Reeds and heavy grass, maintaining a vertical position, are found only on firm soil with clay close to the surface.

In conclusion, I would like to propose a few questions of interest to engineers in this section which, so far as I know, have not been solved but which it seems could be solved from the knowledge that we have, or could acquire, regarding our own alluvial soils.

We know that within reasonable limits certain loads may be imposed with safety on the surface soils, but what are those reasonable limits for each class of soil? And how should the loads be distributed?

We know something of the settlement of buildings which has taken place within several blocks of the river but what precautions should be taken in building a home in Lakeview to prevent warping of doors and cracking of plaster?

We know that lands near the river which have not been loaded have subsided as a result of sub-drainage and we know of extreme cases of deep muck soils in agricultural areas in which the surface is now five feet below what it was before sub-drainage was provided but what may be expected from the same cause in the various residential areas of the city?

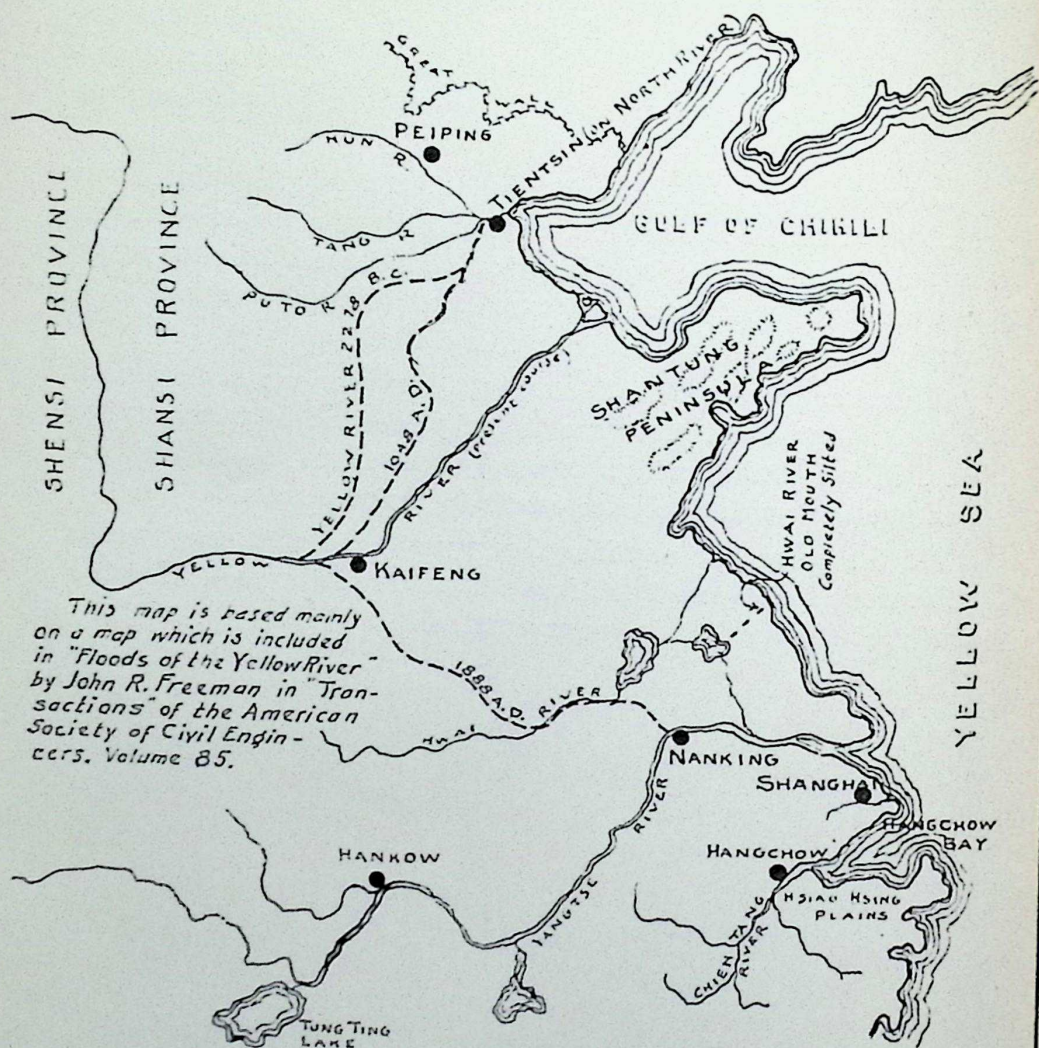
We know that in the construction of levees of substantial section in the alluvial prairies, it takes from two to four or more cubic yards of excavated material to yield one net cubic yard

of levee, and that presumably the filling of large areas would present similar difficulties (though perhaps in a lesser degree). How much of this loss of section is due to shrinkage of the material placed, how much to squeezing out of water from underlying strata and how much to horizontal displacement of substrata?

We know of failures and partial failures of levees due to horizontal displacement. In several instances the sub-stratum movement has forced up ridges of considerable height twenty to a hundred feet from the levee line. What is the most economical method of overcoming this difficulty?

In other words, we think that we know, or can make a good guess, about a lot that has taken place and is taking place but, do we know enough to apply such data to the best advantage and with adequate credit to the profession?

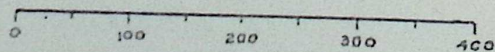
If the answer is anything but "yes," the often-used words of various members of the Brain Trust are in order—"Further study of the subject is recommended."



This map is based mainly on a map which is included in "Floods of the Yellow River" by John R. Freeman in "Transactions" of the American Society of Civil Engineers, Volume 85.

PRINCIPAL RIVER DELTAS OF NORTH-EASTERN CHINA

SCALE IN MILES



ERECTION OF THE SUPERSTRUCTURE OF THE BATON ROUGE BRIDGE

BY E. L. DURKEE *

Read before La. Section A. S. C. E. in Baton Rouge, October 26, 1939.

INTRODUCTION

The bridge over the Mississippi River at Baton Rouge has now been under construction for nearly 30 months. The various contracts for construction were let early in June, 1937, and work on the piers for the main river spans was started immediately. The contract for the superstructure on these piers was let to the Bethlehem Steel Company and included the making of all detail designs of the truss joints, splices, etc., and the shop drawings; and furnishings, fabricating and erecting the steelwork; also the complete railroad deck and the concrete roadway.

The object of this paper is to describe briefly the erection only of the steel superstructure. It will cover the method of shipping and handling the fabricated steel members; the type of erection equipment used; the method of erection, known as balanced cantilevering; and the method of connecting the spans cantilevered out from adjacent piers.

GENERAL DESCRIPTION

The Baton Rouge Bridge was designed, and will be owned and operated by the Louisiana Highway Commission as a toll-free structure. The L. and A. Railroad Company is paying a share of the cost to cover the use of the railway. The Bureau of Public Roads, now the U. S. Public Roads Administration, aided in the financing of the project, and reviewed and approved the designs and details.

The structure provides for a single railway track, designed for E60 loading, between trusses spaced 32 feet apart on centers. Outside of the trusses, on each side of the bridge, is a two-lane concrete highway 20 feet between curbs designed for H20 loading. There is no sidewalk except for a 30-inch wide

* Bethlehem Steel Company.

emergency walk on the outside of each roadway; also a 40-inch wide checkered steel plate walkway on one side of the railway track. There is an ornamental structural steel handrail of heavy construction on each side of each roadway and a wire rope handrail along the outside of the walkway plate.

There are six main piers supporting five spans of multiple cantilever type of structure. There are two 490-foot anchor spans at the ends, and a central anchor span of 650 feet. The other two spans are each 848 feet long, and each consists of two cantilever arms of 226 feet supporting between them a suspended span 396 feet in length. The entire structure is 3326 feet long and is symmetrical about the center-line. A clearance of 65 feet above high water is provided. The trusses are 124 feet deep at the piers and 62 feet deep at centers of spans between the piers. The trusses are generally of the sub-divided Warren type.

The original schedule of pier construction contemplated completion of the underwater work on the two central piers, numbers 3 and 4, before the high water at the end of the year 1937, allowing completion of the upper pier shafts during the winter and early spring so that steel erection could start in April, 1938. The pier program was disrupted and badly delayed because of high water and other unforeseen difficulties so that Piers 3 and 4 were not completed until the spring of 1939, almost a year late.

Field work on the steel superstructure was started on March 1, 1939, when a work barge was tied up at Pier 3, and has been progressing steadily since then except for minor interruptions and delays. Erection of the main trusses and railway deck on Piers 3 and 4, in the center of the river, was completed and the adjacent spans connected early in August. This was followed by erection of the steelwork supporting the two highway lanes cantilevered outside the main trusses, riveting, and painting. The riveting has just been completed on Piers 3 and 4 and painting is progressing rapidly, the final field coat of aluminum now predominating. The railroad track is completed but the highway deck cannot be poured until after the complete erection of all steel some time this winter.

Erection of Piers 2 and 5, from which all remaining steel will be erected, was begun early in September but has been materially delayed because of the low water stage existing throughout the Mississippi and Ohio Rivers. This has retarded the movement of the barges transporting the steel from Pittsburgh, but shipments are again arriving and no further delays on this account are anticipated.

METHOD OF SHIPPING AND HANDLING STEEL

All structural steel for the main river spans is being fabricated at the Rankin Plant of the Bethlehem Steel Company, in the Pittsburgh District. This plant lies on the bank of the Monongahela River only a few miles above its junction with the Allegheny, the confluence of the two streams forming the Ohio River. Since the major portion of the main spans are over the river, and since water shipment is very much cheaper than railway freight, the obvious method of shipment was by barge down these rivers. The establishment of a yard at the site and means for unloading and loading out the steel work would also be a very expensive item of construction. With the large barges available, it is possible to load the steel members arranged so that they can in most cases be lifted directly from the barge into place in the structure, and this method was decided upon.

The entire structure was therefore divided into barge shipments, lettered and numbered to correspond to the piers and the various derrick positions or stages of erection on each pier. Furthermore, for each derrick position during construction the order of erection of each member was carefully worked out and the pieces in each barge shipment were then loaded in the reverse of this order. Thus the material required first was on top of each barge load, or placed so that it could be reached without moving any other members, as far as possible.

During erection, the barges are anchored in the river directly under the erection derrick or traveler, which hooks onto the members and hoists them directly into place. The barges are spotted in position by a tug held by wire rope anchor lines fastened to heavy concrete anchors dropped in the mud at the bottom of the river. Each barge is held by one and sometimes

two upstream anchors, and either one or two downstream anchors, the latter to prevent its whipping around in the current. The use of manila anchor lines had to be discontinued as the excessive amount of silt carried by the water quickly filtered into the fibres and the continued working of the rope soon caused the strands to chafe and cut.

The U. S. Engineers Office allowed the closure of all but one of the navigable channels. The barge anchored in that channel has two lines connecting it to the work barge at the foot of the pier. By hauling in on these lines and slacking off on the anchor lines, this barge can be moved in to the pier quickly and without the use of a tug. Very little interference with navigation has been encountered as at least half the main channel is always open, the barges never going beyond mid-span from the adjacent pier. The west channel has also been kept open to the same extent but the center channel was practically closed while erection was going on.

On the west side of the river, Pier 5 is located well back from the channel and is on dry land except during the higher river stages. The west anchor span between Piers 5 and 6 crosses the levee so that the steel for this span could not be picked directly from the barges by the erection derricks. To make this span accessible, a timber dock approximately 104 feet by 133 feet in plan was constructed on the west shore, just north of the bridge and far enough out so that barges could come alongside at the lowest water stages. A stiffleg derrick was mounted just north of the dock and so located as to cover the entire dock area. The elevation of the deck was kept at 40 feet on the assumption, or hope, that no higher river stage would be encountered this season. The water actually rose to elevations 38.9, early in April.

From the dock a curved timber trestle was constructed running back to and through the opening in Pier 5, and continuing on the centerline of the bridge west across the levee and to Pier 6. Another tangent portion of trestle extends east to Pier 5 to a point where deep enough water is encountered to float a barge. All steel for the west anchor arm is being unloaded from barges at the dock and run out over this trestle.

on flat cars running on a standard gauge railroad track. The same is true for all steel east of Pier 5 which cannot be picked direct from barges.

The dock also serves as a small storage area for miscellaneous tools and equipment and for some steel members which cannot be shipped in proper sequence. It is also used for the storage of ties and rails for the railroad track and as a working platform for assembling the track in sections of 33 feet or 40 feet in length, corresponding to the truss panel lengths, for erection as a unit rather than piece by piece.

Steel for the east anchor arm, which is also partly over dry land even at flood stage, will be hoisted directly from the barges to the deck by one erection derrick and run back over the railroad track to the other erection derrick.

ERECTION EQUIPMENT

After the method of shipping and handling the steel was settled upon the actual erection equipment to be used had to be determined. Practically every conceivable type of derrick or traveler (the bridge builder's term for a derrick designed to move over a bridge or other structure) had been used in the erection of large bridges. Up until ten years ago, a stiffleg or A-frame derrick, mounted on a platform and with either skids, rollers, or actual wheels to enable it to move, was the standard bridge traveler. Sometimes the derrick was elevated on a special underframe, either to enable it to set members at a greater height, or to permit material to be brought out over the same deck on which the traveler is working and directly underneath the derrick to where the material can be picked up. The disadvantages of these two types of derricks are, first, the high boom stresses due to the relatively short height of the mast or A-frame; second, their great weight; and third, their restricted working area which makes it impossible for them to reach around behind themselves to pick material or fill in bracing and other members which cannot be erected until the derrick has passed.

About 1929 one of the large fabricators and erectors started the use of guy derricks in bridge erection. This type of der-

rick has the advantage of a long relatively light boom of large capacity, because of the long mast employed; it is usually much lighter for the same capacity than any other type of derrick; and the boom has an unrestricted working area of 360 degrees. The disadvantages of the guy derrick are the many guys required, the difficulty of locating suitable guy anchorages on a bridge, and the flexibility of the guys. On a narrow bridge, the side guys must be correspondingly steep with a consequent reduction in derrick capacity. One way of overcoming this is the use of projecting outrigger beams or "jigger-sticks" to which to fasten the side guys, but these must be removed and re-erected each time the derrick is to be moved. Also, the forward guys are difficult to maintain unless forward outrigger beams are used. The first attempts to use guy derricks involved a number of serious accidents and their use is still by no means general. It is usually particularly difficult and dangerous to first get them set up and started working.

For the erection of this structure a novel adaptation of the guy derrick was used, perhaps for the first time. After the derrick was once set up and the first truss member erected, all of the mast guys were replaced by two stifflegs running from the top of the mast down onto and fastened to the top chord of the trusses. This gives in effect a huge stiffleg derrick with a mast 105 feet high and utilizes the truss members already erected as a part of the derrick. By proper design and proportioning it is still possible for the boom to turn completely around and under these stifflegs. We thus have all the advantages of both types of derricks without the usual disadvantages. The greatest drawback is in getting set up and which still involves the use of guys until truss work is erected to use the stifflegs.

Four traveling derricks of this type are in use here, two working in opposite directions on each pier. One is of 40 tons and the other of 35 tons maximum capacity. The heaviest members in the structure are located over or near the piers, so that only one derrick of the heavier capacity is required. To start erection, the 95-foot boom of one derrick is first erected in the recess in the pier shaft just above high water level and guyed

off from the top of the pier, thus making what is known as a Chicago boom. This boom first erects an inclined falsework bent supported on the pier itself and with the upper end tied back to the top of the pier; then a temporary working platform supported on top of the pier and on the bent. The boom is supported on a special frame which is then raised or jumped to near the top of the pier carrying the boom up with it, still guyed off to the pier top. In this position, it proceeds to erect the 105-foot mast on the platform as a base, guying it off to the platform beams. The side guys are connected to outrigger beams supported on the platforms. The mast then picks up the boom and pins it off to the mast heel and thus the first guy derrick is erected and ready to start work. Three panels of truss can be erected from this position, but only for half the 124-foot depth of the truss at the piers.

To enable the derrick to reach the top-most member over the piers, two panels of temporary floor are erected at the mid-height of the trusses and the derrick is jumped up onto this floor as a working platform. From here, the trusses are topped out and the second derrick is erected, on the lower floor, using the stifflegs. The first derrick then moves forward, jumps back down to the main deck, erects its own stifflegs, removes the guys, and is then ready to proceed with erection.

These derricks are each operated by a 100 horsepower 3 or 4-drum steam hoisting engine located on a barge anchored to the pier. These engines remain on this barge while the two travelers move away from the pier, the lead lines being run up and out to them through special sheave boxes. The advantage of leaving the engines at water level is obvious. Fuel and water are more easily supplied, and engines of this size and weight would be difficult to raise to the bridge deck and equally difficult to remove. The difficulty of signalling is easily overcome by the use of an electric light signal system, the lights, two for each drum, being mounted directly in front of the hoisting engineer and operated by the signal man on the traveler through the use of push-buttons and a multiple strand armored cable. The system is positive and safe, and permits very delicate adjustment of the loads being handled.

Also located on the engine or work-barge, are three fuel oil compressors which furnish air for riveting and for the operation of air hoists and other air equipment. The traveler derricks are revolved or swung by means of small, air operated, two-spool swinger engines mounted on the traveler platform. Automatic air-operated bolt machines are used for fitting up joints and splices instead of the usual forked hand wrench. Some of the rivet heating forges are connected to an air line instead of to the usual hand-operated forge fan. Since work is carried on simultaneously at two piers, two complete sets of equipment as enumerated above are required. Two engine barges are employed, one at the base of each pier, upon which erection is progressing, each carrying identical equipment, that is, two steam hoisting engines and three fuel oil compressors, together with various fuel and water tanks. At Piers 2, 3, and 4, the engine barge is tied up directly at the base of the pier but at Pier 5, it is anchored 160 feet east of the pier, which is as close as it can get at low water stages.

At the dock is a 60-ton capacity stiffleg derrick with a 90-foot boom and an 11-foot job, operated by a 100 horsepower 3-drum steam hoisting engine, making a total of five of these engines on the job. This derrick and engine are mounted on a fixed platform adjacent to the dock and at the same elevation. The derrick covers the dock area and can reach out over the water-front side to unload material from barges.

Material is run out over the dock trestle on standard railroad flatcars hauled by a 15-ton gasoline locomotive. An auxiliary gasoline compressor is on hand for emergency service and also two additional fuel oil compressors. All three of these compressors were used temporarily in a third barge at Pier 3 to furnish air for riveting after the engine barge was removed.

In addition to the two engine barges and the auxiliary compressor barge, another small steel material barge is employed for transferring the railroad deck, tools and equipment between the dock and the work on the piers. Otherwise, all steel is handled from the same barge in which it is shipped. A blacksmith shop is housed on a timber barge anchored on the

cast side of the river, and this is also used as a landing barge. Two additional timber barges are in service used mainly for loading, storing, and transferring lumber and small supplies, and serving as landing platforms on both sides of the river. They are never used for handling truss members or any important equipment, the loss of which would be a serious thing.

Two tugs are employed, one large one for shifting loaded barges and a smaller one for general use. Both tugs are used to transport men to and from work on the piers and at the dock.

METHOD OF BALANCED CANTILEVER ERECTION

Starting erection on an intermediate pier of a bridge and building both ways by cantilevering is not an unusual procedure. The original time schedule for completion of the Baton Rouge piers was such that numbers 3 and 4, in the middle of the river, were expected to be the first finished and steel erection would have to start there to take full advantage of the working time allowed under the contract. This also fitted in very well with barge transportation of material and double cantilevering was therefore decided upon.

In this method a falsework bent is ordinarily driven adjacent to the pier, the two supports thus forming a base or platform on which to build. Additional falsework bents are often used, as may be necessary or desired. Adjacent to Piers 3 and 4, however, there is encountered the deepest water in the river, 70 feet at low water at Pier 3 and 46 feet at Pier 4. During construction at least a 50-foot river stage was to be expected which would give 100 feet of water at Pier 3 together with a swift current and consequent dangers from navigation and driftwood. With a soft mud bottom subject to continual scour, it would be impossible to drive a safe pile foundation.

A falsework bent had to be used, however, and the logical place to support it was on the caisson underlying and supporting the pier shaft itself. This method was used and a steel anchorage was built into the 12-foot thick concrete block forming the top of the caisson at elevation—25 feet, and located 16'-7" out from the center of the pier. This anchorage supported two pin-connected steel columns running up beside the

pier shaft to elevation +30 feet at which point they were braced by pin-connected struts embedded in the pier. All of this material was erected by the pier contractor at the time each pier was built, and is referred to as the lower falsework bent.

The upper falsework bent pins off on a common pin at elevation +30 feet and is inclined so the top comes directly under the first truss panel point 40 feet from the center of the pier. The top of this bent is held by a pair of steel struts or ties connecting to the shoes on the pier. A short link, pin-connected at each end, supports the bottom chord on top of each falsework column. This link is adjustable in length and contains a 500-ton hydraulic jack for adjusting the length while under load. The bent is designed to take load in either tension or compression but adjustments in length can be made only when the load is in compression. Using the bent in tension allows for unbalanced load on either side of the pier without the need for a second bent on the opposite side of the pier. Each falsework column is made up of three I-beams forming a compound H-section and the beams themselves, as far as possible, are to be cut apart and refabricated as permanent stringers in the highway floor.

The pin connection at elevation +30 feet was selected in the belief that the upper bent would be erected before the spring flood attained that stage, but the river reached it first. At both Piers 3 and 4 the pins had to be driven under water, 3 feet deep at Pier 3 and over 8 feet deep at Pier 4. This was done by supporting the pins in driving position on a special framework attached to the upper falsework column which was carefully lowered in place and the pin driven by pulling it into the pin holes with a wire cable. A diver made sure that the operation was correctly performed.

No other falsework bents are used between Piers 2 and 5 except those at the piers because of the difficulties already mentioned. Each of these spans is being erected by cantilevering its full half length and then joining the two halves at mid span. The side anchor arms however, both of which are partly over dry land, will be supported by a second falsework bent

somewhere near their mid-length, thus providing an added measure of safety and eliminating all dangers inherent to balanced cantilevering.

The method of erecting the falsework bents and getting the derricks set up on top of the pier has already been outlined. With both derricks erected, facing in opposite directions, true balanced cantilever erection is ready to start. Since the entire superstructure including any load on the falsework is supported by the pier and caisson, it is obvious that any unbalanced load must be resisted by the stability of the pier itself. Any load on the falsework produces an overturning moment on the pier and its foundation and bending stresses in the upper pier shaft. In setting up a criterion for pier stability due to unbalanced loads, the uneven bearing pressure under the caisson was the only resisting factor considered. The supporting effect of the material surrounding the caisson was entirely neglected and is an additional factor of safety. After considerable study an unbalanced moment on the pier equivalent to a load of 100 tons in the furthest erection position out from the pier at any time (320 feet maximum) was assumed. This together with a 20-lb. wind pressure acting on the pier and superstructure produces an excess toe pressure of about 2900 lbs. per square ft. in the worst case, but both it and the maximum total pressure are less than for the worst loading condition assumed for the design of the completed structure. In computing these pressures the effect of buoyancy on the submerged portion of the pier was considered, also a skin friction of 500 lbs. per sq. ft. on the sides of the embedded caisson.

During erection there is the constant necessity for maintaining the unbalanced load within the above limit and making sure that it is never exceeded. Although the established criterion is an arbitrary one, there is still a possibility of a large steady unbalanced moment in one direction producing a permanent lean of the pier in that direction. Some method had to be developed whereby the erection force could easily, quickly and accurately determine the amount of unbalance at any stage of erection and for any possible combination of erection steps for the two derricks working on each pier. This was accomplished as follows.

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A tabulation was made showing for each derrick position the piece mark of each member to be erected, the order of erection, the weight of each piece on each truss, the moment arm from the center of the pier, the reaction of each individual piece on the falsework bent and the total reaction of all pieces on the falsework bent. For members on the same side of the pier as the falsework, these reactions are all positive, producing compression in the falsework columns, and for those on the opposite side of the pier they are all negative, that is, they produce tension in the falsework. For any stage of erection for the two travelers the difference in the total reactions gives the net reaction, and this is a quick and simple calculation. To further simplify matters, a step number was given for each member erected and opposite each step number for either traveler there are given the limiting step numbers for the other traveler, making it unnecessary to perform any calculation whatever. Note that the balancing criterion is a variable moment, not a constant one, and is due to a 100-ton load at the farthest position of erection at any time. The maximum permissible load on the falsework therefore varies with the stage of erection.

To help keep the out-of-balance moment on the pier within the permissible limit, and to allow each erection derrick the greatest amount of freedom possible in its work, a balance car is used on the bridge deck. This is an ordinary standard 40-foot railroad flat car loaded with a truss chord and some rails to bring its total weight up to 75 tons. It can be moved the entire length of the erected structure in back of the two travelers. If for any reason one derrick should be at the limit of its permissible erection and would otherwise have to stop work until the other derrick caught up, the balance car can be moved out toward the second derrick and thus maintain a balance which will permit erection to continue for a further period without interruption. With many of the main truss members weighing 30 to 40 tons, this is of considerable help as one derrick erecting heavy truss members may quickly run out of its quota of work while the other derrick is busy in erecting a larger number of small bracing members which may take considerable time but add little weight.



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A positive check of the load on the falsework bent is possible, when the resultant reaction is in compression, by means of the 500-ton jack in the link between each falsework column and the truss. The load in the link is ordinarily taken directly through steel plate shims into the column but by pumping up the jacks, the shims can be loosened and removed and the load carried entirely on the jack. Accurately calibrated gauges are furnished with each jack pump and thus provide means of weighing the reaction. Weighed reactions were found to agree within 5 to 10 per cent of the computed ones and several times agreed almost exactly. The variation is greatest for small loads, and is usually quite small for large reactions.

METHOD OF CLOSING SPANS

Among engineers and laymen alike one of the questions most frequently asked about bridge erection is how a continuous structure cantilever out from two adjacent piers can be connected and closed when it meets, taking due account of varying temperatures as well as inaccuracies in fabrication and in location of pier centers. Two types of construction to be so closed are encountered at Baton Rouge. Between Piers 3 and 4, the trusses are truly continuous, being fixed on Pier 3 and supported on a rocker shoe at Pier 4. Between Piers 2 and 3, also between 4 and 5, there are two cantilever arms supporting a suspended span between them. The trusses are discontinuous at the ends of this suspended span but are temporarily made continuous during erection, so they can be cantilevered.

The answer to the question is that no attempt is made to make the two ends meet exactly as they are erected, but rather to make them miss. In the case of a continuous structure such as between Piers 3 and 4 the span on Pier 4, which is on a rocker shoe, must be fixed in position during erection and this is done by temporarily locking the upper and lower shoes together, the rockers being in between. This was done and in such a position that regardless of temperature, and assuming certain inaccuracies of construction and pier locations, the ends of the two spans would still be too far apart when the closing chords were erected. The amount the one span was drawn back was 5 inches and allowed for a maximum tem-

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perature of 120 degrees, possible errors of an inch in fabrication and pier location, and a half inch or so to spare. The closing was effected early in August and when the center chord was erected it was about $2\frac{1}{4}$ inches too short, almost the entire difference being accounted for by temperature alone.

With all closing truss members erected a specially designed jacking frame was erected over the still open bottom chord joint in each truss, bolted to each of the adjacent ends and wedged tight. The rocker shoe at Pier 4 was then freed so the rockers could function and the span was pulled together by the jacking frame at the center until the bottom chords matched and could be fitted up. The jacking force required was about 120 tons per truss and well within the capacity of the two 100-ton hydraulic jacks provided in each frame.

The two halves of this span had been purposely erected somewhat higher than their true position by jacking them above their normal position at the two falsework bents adjacent to the piers. Thus when the bottom chords at mid span were closed, the top chords were still open about $1\frac{1}{2}$ inches. Carrying the load on the jacks at the falsework bents and lowering them as required rotated the two halves downward thus bringing the top chords to closure and also permitting the diagonal truss members in the closing panel to be connected. After sufficient fitting up to take the load, the jacks were slacked off until they were entirely free and all load removed from the falsework, thus completely swinging the span between the two piers.

Between the other piers, where the suspended spans are being cantilevered, a slightly different procedure will be used but the general principle involved is the same. The chord members at the ends of the suspended span, and which carry only the temporary erection stress, are made adjustable in length and each contains a 500-ton hydraulic jack. The load is carried on steel bearing shims except when adjustments are being made. The top chord jacking member has a telescoping arrangement which permits the jack in compression to resist the tension stress in the chord and also permits of changes in length while under load. With jacks in all four chord members at one end of the suspended span that portion of the structure can

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be moved in any direction within the limits provided. It can be moved in or out so as to lengthen or shorten the gap at mid span, and it can be rotated up or down and even sideways if that should be required. The other half of the span has jacks only in the top chords thus permitting vertical rotation but no movement endwise.

At the start of erection the adjustable members are so set as to rotate both halves of the span upward, and to cause an overlapping of the bottom chords and too great a distance between the closing top chords. The overlapping in the bottom chord is provided for by a short removable section of loose plates only 4 inches in length. The closing operation then consists of first slacking off the bottom chord jacks at one end of the suspended span and the top chord jacks at the other end which both lowers and trusses and shortens the bottom chords until the overlapping is eliminated and the closing joints can be connected and fitted up. The adjustments are such that at this stage the top chord joints still stand slightly open. They are closed by slacking off the top chord jacks which lengthens these chords and thus closes the final gap. After the diagonal truss members can be connected, and which may require some further manipulation, all jacks may be slacked off and the suspended portion swung as a simple truss span between the cantilever arms. Note that this entire closing procedure involves only the slacking off of the jacks under load which makes for ease, speed and precision of movement. The only pumping up of the jacks is that required to pick the load up off of the shims.

For the end or shore anchor arms no special provisions are necessary to land on the end piers, numbers 1 and 6, except that the trusses must be high enough to permit erecting them over the shoes. The deflection of the trusses will be counteracted by jacking up on the falsework bent in these spans and they will be swung by simply lowering the outer ends onto the bearing shoes.

CONCLUSION

In the above discussion, it should be noted that only the main trusses, floor and bracing are erected during the cantilevering operations. The highway floor outside the trusses is

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not erected until the supporting span has been closed. Highway erection is by means of a small traveler consisting of an A-frame derrick mounted on a platform which can be rolled along over the highway stringers. Power is supplied by a small gasoline hoist mounted on the traveler platform. A total of four of these small highway travelers will be used, two of which are already in operation. Material is picked directly from barges when over the river and is handled the same as for the main steel where this cannot be done.

Erection of all steel is expected to be completed by about February 1st and pouring of the concrete highway decks will require another three months. The bridge is now expected to open to traffic some time in May.

She: "Sir, I'll have you know I am marrying an engineer and a gentleman."

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And the man who objected to a fly in his soup.

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MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the General Meeting of the Society, January 12, 1940.

The meeting was called to order by President Godat with approximately 150 members and guests present.

Presidents and Chairmen of local sections of founder societies, and distinguished guests were presented.

Chairman Stewart of the General Committee announced that the Contact Committee with the Auxiliary of the Society had through error been omitted from the program. Mr. Wade Barnett was Chairman, with Prof. Elliott as Vice Chairman.

Dr. ten Hoor, Dean of the College of Arts and Sciences, Tulane University, gave a most interesting key note address entitled "Cultural Values in Engineering."

A brief report was presented by the Secretary-Treasurer, the full report to be printed in the "Proceedings."

President Godat gave a brief report, summing up the various activities and events materializing during his 1939 administration.

Chairman Grehan of the Tellers Committee presented his report on the letter ballot electing officers and Board members of the Society for 1940. The following were declared elected: President, W. H. Rhodes; 1st Vice-President, B. S. Nelson; Second Vice-President, C. W. Ricker; Directors to serve 2 years, L. J. Lassalle, K. P. Kammer. Secretary-Treasurer, A. M. Hill.

Retiring President Godat presented President Rhodes with the new gavel. The newly elected officers and Board members were escorted to the front, and presented to the members present.

There being no further business, the meeting adjourned.

A. M. HILL, Secretary-Treasurer.

Minutes of the Board, January 15, 1940.

The meeting was called to order by President Rhodes with the following present: Barnett, Crump, Godat, Kammer, Nelson, Ricker, Hill.

The membership of the various standing committees was reviewed, some changes being made.

A committee consisting of Messrs. C. M. Kerr, W. H. Rhodes, D. W. Godat was appointed to present a resolution on the death of Mr. Floyd Hamilton. Mr. Kerr was appointed chairman.

There being no further business, the meeting adjourned.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Board, February 12, 1940.

President Rhodes called the meeting to order with the following present: Barnett, Godat, Kammer, Nelson, Ricker, Hill.

Minutes of the previous meeting were read, and one correction made.

The question of the manner of making refunds to the Baton Rouge Section was discussed. In accordance with the provisions of the amended Constitution, Article X, Local Sections, the Secretary-Treasurer was di-

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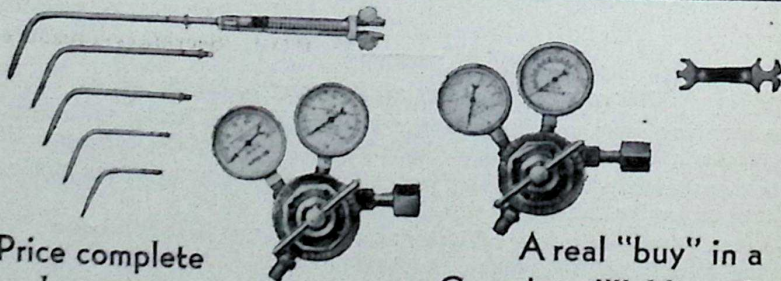


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rected by the Board to make refunds in the following manner. At the end of each quarter a refund at the rate of one dollar per six dollars collected from state members and state junior members, would be sent to the Secretary-Treasurer of the Section. Fifty cents will be refunded on each \$1.00 student dues collected from student members of the Section. These refunds as above described are to be made at the end of each quarter on collections made during that quarter.

The Budget for 1940 was presented and approved by the Board.

The report of the Annual Meeting in 1940 was presented, and accepted. It was voted that Mr. David W. Stewart, General Chairman, receive the thanks and gratitude of the Board for holding the expenses within the budget, and at the same time putting on such a splendid meeting.

There being no further business, the Board adjourned to the regular meeting of the Society in the Hunt Room.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Society, February 12, 1940.

The minutes of the previous meeting were dispensed with, President Rhodes calling the meeting to order with approximately 75 members and guests present.

The meeting in Baton Rouge of the Section was announced, and President Pegues invited the New Orleans members to attend. The date, February 21.

An invitation was presented from Dean Woolrich to attend the Third Texas Conference on Soils Mechanics.

Dr. Mabel Wood spoke briefly on the Woman's Field Army for the Control of Cancer. She introduced Dr. Ficklin, who presented a short paper on the cancer situation.

Mr. Arthur J. Naquin announced plans for the St. Patrick's Day party of the Woman's Auxiliary. He urged members to purchase tickets for the event.

President Rhodes then introduced Col. Arthur M. Shaw, who spoke on "River Delta Formations with Special Reference to Their Effect Upon Engineering Design."

Mr. John Klorer gave a brief supplementary discussion. A number of questions were answered.

The speaker was tendered a rising vote of thanks, and the meeting adjourned to the usual collation.

A. M. HILL, Secretary-Treasurer.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

APRIL, 1940

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STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

Special Meetings at
call of President

On March 25th a meeting of the Section was held at Charity Hospital, in New Orleans, where a paper on "The Structural Effects of the Foundation Settlements of the Charity Hospital Building, and the Structural Reinforcement Undertaken" was presented by Mr. George P. Rice, M. Am. Soc. C. E., Consulting Engineer of New Orleans.

After discussion of the paper by Mr. Rice opportunity was afforded all those present to inspect the work now under way in the Chapel of the Hospital which is the only portion of the building requiring reinforcement against future trouble.

The Section was the guest of the Society of American Military Engineers at their meeting in the St. Charles Hotel, New Orleans, on the night of April 25th and enjoyed a most excellent illustrated talk on the construction of the Sardis Dam in Mississippi, the largest earthfill dam constructed in this country to date, by Lt. Col. R. G. Moses, Corps of Engineers, U. S. Army.

During the week end of April 28th and 29th the Section was honored by a visit from Col. John P. Hogan, President, and Mr. George T. Seabury, Secretary, respectively, of the American Society of Civil Engineers of New York City.

On Sunday the 28th Col. Hogan and Mr. Seabury were the guests of the Second District U. S. Engineers for a boat ride to the Bonnet Carre Spillway. On Monday they were guests at a luncheon given by the Waterways Transportation and Development Committee of the New Orleans Association of Commerce at La Louisiane Restaurant, where Col. Hogan made a brief talk on the value of waterways to this community and his pleasure at the splendid development of the Louisiana and Texas ports and inland waterways.

Monday night a meeting of the Section was held at the St. Charles Hotel, where Col. Hogan and Mr. Seabury were guest speakers. Mr. Seabury discussed Society affairs and explained what was being done and plans for the future to help the Civil Engineer both technical and economic development. Col. Hogan talked on the problems confronting the Civil Engineer and what must be done to correct present maladjustments both as to the profession and as to our Nation since the welfare of one is bound to the welfare of the other.

On Monday morning Col. Hogan and Mr. Seabury addressed the Student Chapter at Tulane University. Prior to this the Chapter had an address, on April 18th, by Mr. J. A. LePrince, eminent Sanitary Engineer, on "Malaria and Yellow Fever Control in the Tropics;" and on April 25th made an inspection of the Jones-Laughlin Steel Company's plant.

The L. S. U. Student Chapter of the Society enjoyed a talk by Mr. LePrince on April 19th and also an illustrated talk on the Galveston Causeway and Construction of the Neches River Bridge by Mr. G. G. Wickline, Bridge Engineer of the Texas Highway Department. On May 10th the Chapter will celebrate its annual "Engineers Day" and the Spring Meeting of Louisiana Engineering Society.

THE PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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The last name on each committee is the Junior member, who sits with the committee, but without vote.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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JUNE, 1940

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EDITORIAL NOTES AND COMMENT

A Big Job Ahead. The engineer is frequently a man of contradictions. While it is true that he is continually improving devices to go deeper and deeper into the water and the earth, so it is also true that his airplanes are reaching higher and higher into the heavens.

If he has made life more bearable by making it more comfortable, so too have his engines of destruction made war and death more horrible. He has invented countless devices for saving lives and he has invented devices which put death on a mass production basis. In his benevolent works of construction he has taken joy and pride. The creation of engines of destruction has been forced on him against his will and to his sorrow.

The engineer has shown himself equal to any material task. But there is a field where he has not yet applied his special abilities, a field intangible yet real—the field of the hearts of men. Is there no way by which engineering can be applied to human hearts? Could it be so, the destructive elements in human nature would disappear. A world now on fire would no longer burn. A job worthy of the abilities of the engineer awaits him. Can it be done? “’Tis a consummation devoutly to be wished.”

Papers In This Issue. We are printing in this issue a paper entitled “Quick Freezing, Its Economic Development and Most Recent Discoveries,” by Dean W. R. Woolrich of the University of Texas. This is an interesting exposition of a late development in food preservation. Dean Woolrich speaks with authority, since he has been investigating the field of quick freezing for a considerable length of time. His investigations and resolutions have added much to the knowledge of food preservation by quick freezing. His paper, which was read before the joint meeting of the Society with A. S. M. E. on April 8, makes interesting and instructive reading.

There is also printed in this issue an interesting paper by Mr. George Earl on “The Necessity for the Ten Thousand Second Feet Diversion at Chicago and How It Can Be Maintained to the Equal Benefit of All Legitimate Interests.”

The paper deals with a subject with which Mr. Earl is fully acquainted. He has testified before various Federal committees on the need for the proper amount of water being diverted at Chicago. It is a paper worthy of the attention of engineers in the Mississippi Valley.

Junior Membership Awards. Each year the Society awards a one-year Junior Membership to the outstanding Senior at Tulane and L. S. U.

This year the awards go to Mr. Charles Bittenbring, Jr., a senior in the Civil Engineering School at Tulane, and Mr. Hyman Samuelson, a senior in the Civil Engineering School at Louisiana State University.

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

Adams, Fred R. State Member. Endorsed by N. E. Lant, J. P. McCullough, C. A. Ives. B. S. in Elec. Eng. Miss. A. & M. College 1922. Exchange engineer So. Bell T. & T., New Orleans, La., 1923-26. Toll engineer 1926-31. District Engineer, Baton Rouge, 1931-date. 930 Camelia Avenue, Baton Rouge.

Bruns, T. C. Local Member. Endorsed by W. H. Rhodes, Alvin Fromherz, Col. Tompkins. Graduate of Tulane in Civil Engineering, 1928. Entered employ of Doullut & Ewin, general contractors. Wide variety of engineering work. Now engaged in private engineering practice. At present engaged in estimating cost of airport and exploring commercial possibilities at Charlottesville, Va. Address: 2308 Prytania Street, New Orleans.

Davis, Howard F. State Member. Endorsed by C. A. Ives, Jr., Leo J. Muse, R. B. Richardson. Grad. of Univ. of Tenn. 1928 B. S. in C. E. Instrumentman Tenn. Hwy. Dept. 1928-29. Instrumentman power house, Stone & Webster, 1929-30. Project engineer, Tenn. Hwy. Dept. 1930-31. Instrumentman, Road design, and resident engineer, 1931 to present. Address: 712 St. Hypolite Street, Baton Rouge.

Day, Anon D. State Member. Endorsed by L. J. Lassalle, W. B. Gregory, F. H. Fenn. Grad. of L. S. U. in Arch Engineering. Junior engineer and asst. eng. Federal Works Agency. Engineer, DuPont Co., Baton Rouge. Address: 2945 Elm Street, Baton Rouge, La.

Edwards, Elmo J. Local Member. Endorsed by A. M. Hill, Donald Derickson, B. H. Grehan. Grad. Tulane 1933 in C. E. 1933-36 employed by Modjeski, Masters & Case, Inc., in the capacity of asst. engineer during the construction of the Mississippi River bridge at New Orleans. 1936-37 field engineer, Geo. J. Glover Const. Co. 1937-date, Johns Mansville Products Corp. Industrial Engineer. Address: 2030-A Broadway Street, New Orleans.

Floyd, Columbus. Local Junior. Endorsed by A. M. Hill, A. L. Dunlap, J. M. Robert. B. S. in Met. Engineering, 1936,

Univ. of Kentucky. Feb. 1936-Sept. 1936 American Rolling Mill Co., Middletown, Ohio. June 1937, M. S. in Met. Engineering at Univ. of Ky. June 1937-Oct. 1938, Am. Rolling Mill Co. Oct. 1938-Oct. 1939, U. S. Steel Corp. Oct. 1939-present, Instructor in Mech. Eng., Tulane University.

Hays, Arthur C. Local Member. Endorsed by D. W. Stewart, K. P. Kammer, F. G. Frost. Grad. of Alabama Poly. Inst. 1923. Engineer and sales for 7 years with Allis Chalmers Mfg. Co. of Milwaukee. Ten years as manufacturers agent. Address: 1415 Carondelet Bldg., New Orleans.

Holland, Joseph A. State Member. Endorsed by A. D. Jackson, S. C. Magaw, Geo. Lambert, Jr. B. S. in C. E. from Ala. Poly. Inst., 1921. Draftsman La. Hwy. Comm., 1922, 1937, 1939. Junior highway engineer, Illinois, 1923-24. Caddo Parish, 1925. J. N. Chester Engineers, 1926. J. B. McCrary Engineering Corp. as resident engineer, water and sewers, 1926-27. Chas. D. Evans, as supervising engineer, 1928-29. Koch & Fowler, consulting engineers, as resident paving engineer 1930, Dallas. Forshee & Hungerford, Victoria, Texas, 1931. Consulting 1932-34. C. C. C. Camp Commander 1935-39. Edward F. Neild, Arch., 1939. La. Hwy. Comm. 1940. Address: 1822 Perkins Road, Baton Rouge.

Hurd, Robert H. Local Junior. Endorsed by W. H. Rhodes, M. H. Nabors, R. F. A. Benson. Grad. Ala. Poly. Inst. June 1938. B. S. in E. E. May 1938-Sept. 1938, Mayor Jap Bryant. Sept. 1938-May 1939, Southneastern Underwriters Association, Atlanta. May 1939-date, lubrication engineer, Shell Pet. Co. Address: 4204 St. Charles Avenue, New Orleans.

Jones, Sargent F. Local Member. Endorsed by C. M. Kerr, A. R. Brousseau, A. M. Fromherz. Grad. in C. E. Washington Univ., St. Louis. One year design and erection steel highway bridges. Two years mining and railroad surveys and construction. Two years in building construction. Since Oct. 1939 Asst. with Housing Authority in New Orleans as Division Engineer. Address: 5507 Prytania Street, New Orleans.

Keiler, Arthur R. Local Member. Endorsed by R. T. Burwell, D. W. Stewart, K. P. Kammer. Twelve years design, layout and construction of boilers with New York Central R. R.

Eleven years with Hart Steam Boiler Insp. and Ins. Co. as Inspector, office engineer, Asst. chief inspector and chief inspector. Address: 519 Hibernia Bank Bldg., New Orleans.

Padel, William E. Local Affiliate Member. Endorsed by J. P. Henderson, B. S. Nelson, C. C. Crawford. One year detailing with J. H. Rapp Co., Pittsburgh, Pa. One year detailing and checking with J. H. Hausser Engineer, Chicago. Three and one-half years detailing and checking with Lukens Steel Co., New Orleans. Seven and one-half years detailing and checking with Jones & Laughlin Steel Corp. at Pittsburgh and New Orleans. One and one-half years estimating and designing with Lester F. Alexander Co., New Orleans. Address: 1627 South Carrollton Avenue, New Orleans.

Pierson, James F. State Member. Endorsed by H. B. Henderlite, N. E. Lant, W. H. Rhodes. Grad. of Centenary College, B. S. 1936. Salesman 1925, 1926. Teaching 1926-27. 1927-28 L. S. U. Law School and La. Hwy. Comm. part time. 1929-date, La. Hwy. Comm. Const engineer in charge of asphalt division. Address: 937 Richland Avenue, Baton Rouge, Route No. 2.

Raynor, Leroy P. Local Member. Endorsed by Donald Derickson, Frank Macdonald, A. M. Hill. Twenty-five years with U. S. Coast and Geodetic Survey, engaged in topographic, hydrographic and geodetic surveys in Alaska, Philippines and coastal waters of the U. S. Present rank of Lt. Commander in the Service. Inspector of the N. O. Field Station of the coast and geodetic survey. Address: Room 314, Customhouse, New Orleans.

Sargent, Robert S. Member. Endorsed by W. S. Rainville, Jr., M. H. Bell, J. C. Baine, Jr. Transportation engineer, Miss. Power and Light Co., Jackson, spring 1935-summer 1937. Elec. engineer, Miss. Power & Light summer 1937-spring 1938. Division engineer Miss. P. & L. spring 1938-Aug. 1939. Research Asst. New Orleans Public Service Aug. 1939-to date. Address: 6315 Delord Street, New Orleans.

The following have applied for reinstatement: Marcell E. Crettet, Jr., 6112 Laurel Street, New Orleans, (Local Member). Charles D. David, 1328 Toledano Street. (Local Member). Laurence K. Nelson, 2502 Palmer Avenue. (Local Member).

PAPERS AND DISCUSSIONS

QUICK FREEZING, ITS ECONOMIC DEVELOPMENT AND MOST RECENT DISCOVERIES

By W. R. Woolrich *

Quick frozen foods have acquired the respect and endorsement of millions of American people, yet much of the class of the product that the public is accepting today as a superior quick frozen food will be judged as inferior by the scale of measurement that must be anticipated to be introduced within another decade. This is not so much a criticism of the present product as it is expectation of the projected development of the recently acquired knowledge of the art and science of quick freezing by several investigators.

Quick freezing is freezing at a rate sufficiently fast that there is no appreciable change in the physical or the chemical properties of the product throughout the entire cycle of freezing and subsequent thawing.

The process of quick freezing tends to convert perishable foodstuffs into imperishable products at the time they are harvested, slaughtered, picked, or caught, and maintains them in this condition until they are delivered to the final consumer and defrosted ready for cooking or consumption.

This process differs but little from that of sharp freezing, yet most generally the results are a much superior product upon defrosting. A brief discussion of the differences between quick freezing and sharp freezing may aid to distinguish between the two methods.

In the process of sharp freezing the element of time of freezing is not highly important. The cold storage sharp freezer room is generally kept at 0°F to -20°F and freezes products to these temperatures in still air. Fish, canned eggs, barreled berries and fruits in sugar syrup, butter, ice cream, cook-

* Dean of Engineering at University of Texas. Read before the Joint Meeting of L. E. S. and A. S. M. E. on April 8, 1940.

ing compounds, cream and poultry are often processed in the sharp freezing room, then transferred to the freezer storage room to be held until needed.

The destructive action of slow freezing is of such a varying nature that it has caused much controversy and speculation. The results obtained by quick freezing that were impossible with sharp freezing encouraged much conjecture and many premature decisions. These varying conclusions were generally projected with limited research and without a knowledge of all of the factors involved.

Up until 1932, each investigator had his own theory to explain the phenomena of quick freezing. Within the past eight years however, there has been more tolerance between these scientists and engineers with a result that distinct progress has been made to coordinate the several theories.

The first theory proposed to explain the advantages of quick freezing was the crystal growth theory of Birdseye and others. In freezing either fruits, vegetables or meats, the size of the ice crystals formed depends upon the length of time required for the products to pass through the zone of maximum crystal formation. It is known that approximately 75% of the water content of these products is frozen between the temperature of 31° and 23° F. As the temperature is lowered below this zone the remaining solution of the foodstuff freezes until the lower extremity of the freezing range is reached. With some products this temperature is below zero Fahrenheit. Until the temperature below the lowest point of this range is reached, oxidation and discoloration will not be completely inhibited. Only when all of the liquid is crystallized as ice is the deterioration reduced to a minimum.

The osmotic pressure theory was proposed by Petersen and others to give an answer to some phenomena that could not be explained by the crystal growth theory. Its relation to the other factors is difficult to determine. Osmosis is the passage of a solvent through a membrane from a dilute solution to a more concentrated one. According to the simplest theory, the solvent moves from a region where its escaping tendency is large (its vapor pressure is high) into a region where its es-

caping tendency is small. No known method of freezing is quick enough to prevent entirely internal osmotic reactions. However, the quicker the freezing, the less the osmotic reaction progressing inwardly just ahead of the ice-face. Slow freezing was believed to permit sufficient passage of the solution to the freezing cell from the less frozen adjacent cell to cause rupture in progressive succession.

The colloidal action within the freezing cells required a third explanation to the quick freezing phenomenon.

Plant tissue is composed of tiny cells, in and between which are chemically complex colloidal solutions containing many solutes. These cells are relatively inelastic and freezing, even though quick, does more or less break down the structure of the cells. When fruits or vegetables are sharp frozen, complete precipitation of the colloidal gel results, causing a separation of the solids and liquids. Upon defrosting, considerable "leakage" occurs leaving the product dry and with an unnatural flavor. When fruits or vegetables are quick frozen, coagulation, instead of precipitation, of the gel occurs. In coagulation there is a stiffening of the semi-liquids contained in the cells, and therefore there is less separation of liquids and solids, retaining to a much greater degree the original flavor and appearance.

Animal tissue is made up of minute cells which are filled with a semi-liquid protein gel. This gel contains a large percentage of water in which are dissolved appreciable quantities of such common salts as sodium, calcium, potassium and magnesium. Animal cells are relatively elastic in comparison with plant cells. Water in these cells does not freeze homogeneously; instead, pure crystalline water ice begins to form as soon as a temperature of about 31° F has been reached. The removal of this water from the gel leaves it more concentrated with a reduction in the freezing point. In quick frozen meats coagulation occurs so rapidly that only microscopic ice crystals are formed and the tissues are not appreciably damaged.

There is much evidence today that each of these theories must be considered in explaining quick freezing. In dealing with such a wide range of products as is met in the freezing

of fruits, dairy products, vegetables, and meats all three factors must be recognized. With some products the crystal formation will have the most significance, with others the principal influencing factor in securing good results will be the osmotic action, while in some instances the lack of reversibility of colloidal action is of paramount importance.

Methods of Quick Freezing

The many inventions of quick freezing can be classified into five types of freezers:

1. Metal plate.
2. Air tunnel.
3. Atomized or fog spray.
4. Liquid immersion.
5. Dry ice pack.

The metal plate freezers appear in a variety of forms including (1) stationary hollow refrigerated plate cabinet freezers for meat, (2) refrigerated diving bell pans submerged in calcium chloride brine, (3) double metal belt frosters arranged to move the product in closed pans through a calcium chloride tunnel, and (4) various forms of refrigerated single plate machines.

The air tunnel designs are nearly as numerous as the metal plate. On account of the fact that air can be used without introducing any taste or odor, and with great flexibility in blowing it through the cooling coils and apparatus, air tunnels have been very popular. The applications of air have included (1) refrigerated air and product passing through inclined revolving drums, (2) conveyors carrying the food through a frigid air tunnel, and (3) metal food containers being pushed through a cold air blast tunnel by the attendants as they prepare and deliver each pan.

The atomized or fog spray system is used for freezing products either exposed or in cartons. A typical installation includes a cabinet on the top and sides of which are pipes in which is circulated the refrigerating medium of a suitable temperature and flavored to suit the packer. At intervals in the

refrigeration pipes atomizers are installed. The liquid is collected, refrigerated, filtered and recirculated by means of a pump. The products to be frozen are placed on trays and the atomized brine allowed to spray over them directly or in cartons.

The liquid immersion process proposed first nearly one hundred years ago by Benjamin of England was discounted by early American investigators because of the handicap of pumping highly viscous brines and syrups. Mechanically, it requires the circulation of a continuous stream of the brine or syrup solution past the product to be frozen and in direct contact with it. But it also requires that means be provided to cool the brine or syrup, and herein has been one of the major design problems.

The experiences with many of the products to be frozen have indicated the desirability of obtaining very quick freezing without the use of very low temperatures. The stability of the solutes within the cells of these products is better when a freezing temperature just below the freezing range is utilized. This would indicate the great desirability of very rapid freezing at not too low a temperature. Liquid immersion offers the fastest transfer of heat of any of the freezing processes for a given temperature difference between refrigerant and product.

In practice each individual piece of fruit, vegetable, fish, or meat is immersed in a circulating solution maintained at a temperature of 4 to 7° F. The freezing time of products taken from the cold room at 35° F and frozen to 7 to 8° F will vary from a few seconds to ten minutes. For example, the freezing time for individual peas is from 25 to 45 seconds and the freezing time for sliced peaches is from seven to eight minutes.

The crystals formed by this process have been found to be smaller than by other commercial forms of quick freezing with the possible exception of carbon dioxide direct contact freezers. The quality of product frozen by the immersion process is generally superior to that frozen by the carbon dioxide direct contact procedure because the low temperatures encountered with carbon dioxide are avoided in the immersion method.

The carbon dioxide or dry ice pack process consists of freezing the packaged products or the individual pieces in dry ice. With the possible sublimation temperatures of solid carbon dioxide of -107° F, the freezing of the product can be correspondingly rapid. In a few locations within the United States solid carbon dioxide is sufficiently cheap to permit competitive operation of dry ice freezers with other methods, but generally its use is confined to experimental quick freezing and in the shipping of quick frozen and sharp frozen products.

The South's Contribution

The historical development of quick freezing in the South can be well divided into that work done prior to 1933, and the work subsequent to that date.

The two centers at which the most work was done prior to 1933 were the Georgia Experiment Station at Experiment, Ga., and the Engineering Experiment Station of The University of Tennessee at Knoxville. Director H. P. Stuckey and Dr. J. G. Woodroof at the Georgia Experiment Station had made extensive studies on the quick freezing of figs and of peaches. It is generally conceded today they tackled two of the most difficult of the common fruits to freeze from the standpoint of quick freezing and subsequent defrosting. One commercial plant was built in Georgia during this period by a successful peanut processor who had been most successful in selling peanuts. He quickly demonstrated his lack of comprehension of the sales problem of frozen foods and likewise, he demonstrated the limited amount of knowledge that all research men had at that time of freezing peaches. The result was that he was forced into bankruptcy. Even today figs and peaches are two of the most difficult foods to quick freeze with satisfactory results.

At the Tennessee Experiment Station the writer introduced the quick freezing problem in 1927 by starting an investigation of the latent heats of fruits, vegetables, dairy products, and meats. Up to this date, less than ten latent heat values of foods had been determined and published by recognized research laboratories. By 1930, twenty-seven products had been investigated by the writer in the Tennessee laboratory and the latent

heat determined. These values were in turn rechecked by his associates, Cooper, Scates, Smith and Tucker. The value of this investigation was not only the establishing of the formula by which other latent heats could be determined but the very nature of the research lead the experimenters into a fundamental understanding as to some of the factors involved in the successful quick freezing of foods. These researches indicated definitely the necessity to freeze products even more quickly than was customary in the existing commercial processes, and further, that freezing at a temperature too far below the lowest point of the freezing range would produce an inferior product. The fact was established that quick freezing required not only a very rapid transfer of heat from the product to be frozen throughout the freezing range, but that the freezing should not be continued at temperatures much below the freezing range.

Up to this time, 1933, in the commercial field of frozen foods, the South had lagged most seriously. This was most unfortunate because if there is one thing that certain sections of the South can produce better than most other areas of the United States it is fresh fruits and vegetables. The Pacific Northwest had a strong hold on the marketing of frozen cherries, raspberries, strawberries, and other similar small fruit, and repeatedly they were preempting the entire field of frozen fruits. Brokers at the food consuming centers of St. Louis, Chicago, Cleveland, Philadelphia, New York and Boston would shake their heads negatively when mention was even made of the possibility of quick frozen fruits originating from any place but the Pacific Northwest.

In 1933, the University of Tennessee Engineering Experiment Station and The Tennessee Valley Authority Division of Agricultural Industries joined hands in a research program to find a method of successfully freezing southern fruits and berries, so that they would be better than the competing product offered from other areas. The next two years were spent by Mr. R. Brooks Taylor, Mr. Mack Tucker, and the writer in investigating the many possibilities in developing equipment that would produce a maximum transfer of heat from the foods to be frozen by a method that could be made commercial. In 1935,

several tons of Southern grown berries were frozen by an immersion process developed by Taylor and Tucker in which berries were frozen in five to seven minutes at zero degrees Fahrenheit in inverted sugar syrup. This inversion of the sugar had been necessary in order to provide a syrup that would have good liquid characteristics at zero F. temperature.

In this same year a third phase of this program was introduced. The Agricultural Experiment Station of The University of Tennessee was prevailed upon to enter a new field in extension service and put on the payroll a man who would go into the national markets and open up channels of distribution of processed agricultural products of the state. Mr. Harry Carlton was selected for this service and spent many months at the brokerage centers of the food industries of the United States. This was a very fortunate selection of personnel and method of procedure. The Eastern consuming centers of the United States soon became conscious of a newly developed frozen product coming out of the South that was of very high quality. Two years later those interested in the frozen food industry of the South had the satisfaction of witnessing Southern grown Blakemore, Missionary, and Klondyke strawberries commanding on the Metropolitan market of New York a two-cent premium over all other berries. Brokers changed their attitude from that of negation to that of complete reception on the idea of marketing the new Southern product.

This development has naturally been furthered by the continued re-design and improvement of the immersion quick freezing equipment. Today, you will find an established industry at Cleveland, Tennessee, that is producing a superior product from Tennessee and Georgia, strawberries, Youngberries, blackberries and peaches, and their product is recognized as a premium fruit in the most exacting markets of the nation.

At Experiment, Georgia, Dr. Woodroof has been engaged during the past three years in determining and measuring the relative value of the available commercial freezing methods on Southern fruits and vegetables. Some of the results have been

of great value in expanding the immersion process of freezing to Southern foods.

His examination of the ice crystal revealed that ice crystals may be increased as much as five hundred times by slowing down the rate of freezing, and in spinach and asparagus the largest ice crystals may range up to one thousand times the size of the cells of these two vegetables. The presence of such large ice crystals within the tissues produces an enormous crushing pressure that ruptures and distorts the cells. Only when the freezing is done quickly enough to produce small crystal masses as small as the individual plant cells can this destructive action be eliminated.

More than a dozen fruits and vegetables, when frozen by immersion, indicated that it was possible, when the pieces were small enough to freeze sufficiently rapid, to produce ice crystals as small as those within individual cells. His studies indicated that when freezing by immersion the heat transfer was rapid enough and the subsequent ice crystals small enough to result in less than one per cent cell rupture and as low as two per cent leakage upon defrosting with no immediate change in color.

He found very little leakage and very little loss of structure was obtained when starchy products such as peas, corn and lima beans were frozen. Due to the springiness of these materials they had a capacity to release and reabsorb large quantities of water without altering their structure. This indicated definitely that rapid freezing is not nearly as important in working with starchy products as it is with those that have a lower starch content.

Dr. Woodroof's researches indicated that the ice crystal patterns produced from the various fruits and vegetables were much smaller when frozen by immersion at zero degrees than when frozen by air blast, metal plate, and in packages. His experiences also indicated that freezing by direct contact with solid carbon dioxide produced crystals as small as those obtained by immersion freezing, but that the direct contact with solid carbon dioxide produced a decided bleaching effect destroying the natural colors much desired by the American consumer.

At The University of Texas, Mr. Luis Bartlett has been working on a new technique in examining products frozen by the different methods. He has also included in his researches a study of the freezing ranges of different foodstuffs. He has introduced the petrographic polarized light microscope to observe the formation of ice crystals at different temperatures and rates of freezing.

His work is an attempt to eliminate the variation by thawing and drying of the slide sections as is necessary in working with the standard microscope. To accomplish the desired results he freezes the material sections and examines it in the frozen state, the entire procedure being conducted in a refrigerated room which may be held at any desired temperature.

The plain surface is prepared on the unfrozen sample. It is then placed against a microscopic slide and frozen by any desired method. The excess sample is then machined off in a special fixture built in the machine shop.

In working with very juicy foods, the sample is first frozen, and a surface planed down on the sample and this planed surface cemented to the slide with diluted Canada balsam. When firmly fixed to the slide the surface is machined off as with solid foods. The polarized microscope allows differentiation of ice by means of interference colors. There has always been much difficulty in recognizing the crystals of water ice from other cell materials by the ordinary microscope. With the polarized light microscope the contrast between the water crystals and other materials is quite marked. While the polarized microscope has been used extensively in geological work this is probably the first time that it has been applied to the examination and identification of water crystals in sharp freezer rooms, but the application and results have been most gratifying.

Bartlett eliminates the variation caused by thawing and drying of the specimen. He is able to preserve the ice pattern of the frozen foodstuffs and examine the size of the ice masses at temperatures to which they have been subjected. He is successfully applying this method of procedure to meats, shrimp, orange juice, vegetables, and solid fruits. In each case they

give very desirable results and he has been able to obtain considerable new information relative to freezing rates, action of ice crystals, and freezing ranges.

Some Economic Factors of Quick Freezing Upon the South

As has been indicated, the development of a superior method of quick freezing within the South has made it possible to place on the American market a quality product that in previous years was considered impossible. Some of the effects of the expansion of this industry to the South might be of interest; for example, Tennessee, North Carolina, Virginia, and Kentucky normally produce one-fourth of America's supply of strawberries. On account of the similar latitudes of these four states this entire crop is often placed on the American market within a span of three weeks' time. The impossibility of the marketing centers of the United States absorbing such a large quantity of highly perishable berries within such a short period of time is very evident. Markets are glutted by such a procedure, prices fall far below cost of production, and thousands of crates of berries remain unpicked.

The disastrous effect of such a procedure was evident in one major producing county where production fell from seven hundred carloads per year to two hundred and fifty carloads per year after an experience of receiving a retail average price for the year of ninety-three cents per crate for prime berries. When we consider that the grower paid twenty-five cents for the crate, twenty-five cents for delivery charge, and twenty-five cents for brokerage, it is not difficult to understand why he was not willing to continue producing and picking a crate of twenty-four quarts of berries for the sum of eighteen cents.

In this same area frozen berries were being imported in relatively large quantities from the Pacific Northwest eleven months each year to supply the raw material needs of a jam factory. The factory owner found that he could not afford to preserve all of his berries over a one-month period for the entire year's needs. He, therefore, resorted to importing berries over an eleven-month period when native berries were not

available, and operated his plant at normal capacity even during the local strawberry season.

The average price received by growers for berries going into the quick freezing plants of America has been approximately \$1.30 per crate and the grower has been permitted to keep the crate. The emphasis of the quick freezing program which originated in 1932 in the Southern area has encouraged and attracted many companies to utilize Southern berries for quick freezing. We can anticipate a steady expansion of quick freezing as new equipment is developed to utilize the immersion and other processes in Southern territory.

Within the fishing industry, quick freezing has much to contribute. At the present time large quantities of Gulf fish and shrimp go on the American market as a low quality product due to the failure of the industry to preserve the product in the fresh state exactly as they pull it out of the Gulf. Considerable research is under way from Miami, Florida to Brownsville, Texas, to develop a better technique for fish, shrimp, and oyster freezing.

Especially in the field of shrimp freezing has The University of Texas found a very interesting field. The shrimp industry has but little history. The Food and Drug Division at Washington which regulates the Inter-State handling of shrimp has only a limited amount of information on the keeping of shrimp. This industry which has an annual value of a million and one-half dollars on the Texas coast alone is developing a new consciousness of its possibilities and of its wide field of application throughout the United States.

Shrimp frozen within a few minutes after they have been taken from the Gulf waters will keep almost indefinitely at zero degrees temperature. There have been, however, mistakes by the industry, and at the present time at some centers of the United States there are several thousands of pounds of shrimp being held by food and drug authorities because they are not in a satisfactory condition. Unfortunately, neither the processor nor the food and drug inspectors know too much about what constitutes unedible shrimp.

The shrimp industry must realize that minutes are valuable after the shrimp are pulled from the Gulf. When they are exposed to atmospheric temperatures, some deterioration sets in and the time of exposure should be shortened to the very minimum if they want to produce a high grade, quick frozen, product to place on the American table.

It would not be well to close this discussion of the economic features of quick freezing in the South without touching upon the expansion possibilities of locker storage in our Southern states. Locker storage consists of suitable freezer storage plants preferably held at zero degrees Fahrenheit in which cabinets or lockers are provided for rental to the residents of the community for the preservation of their meats and perishable fruits.

Within the past decade, approximately two thousand locker plants have been installed in the United States. These are rendering a frozen food service to upwards of three million people.

While probably one thousand of these plants have been unwisely financed and promoted, yet we must recognize they are filling a very great need within the United States and certain parts of Canada.

The refrigerated locker industry operated at or near zero degrees Fahrenheit offers a real service to the farmer and to a large number of thrifty urban families. It is estimated that the average locker user in many areas saves upward of one hundred dollars per year on his household budget, although he increases his family per capita meat consumption by thirty to fifty per cent. The greatest hazard to the industry is to be found in plant owners selecting sites and equipment, and adopting rate schedules and practices that are not conducive to good business practice. There are probably two hundred locations in the Southern and Southwestern states where locker storage plants would be a good investment and render a fair income for an engineer with business ability, and each of these plants would be a factor in improving the economy of the area served. On the other hand, there are a thousand villages and centers that would not benefit by a commercial type of locker storage plant and any attempt to promote such an enterprise would be a misfortune to both investor and community.

Each locker plant is an ideal station as a depository of quick frozen foods. Fully eighty per cent of the products stored in the typical locker plant is meat. Vegetables and fruits have been successfully quick frozen and stored in locker plants but the local supply of fruits and vegetables for locker storage is usually very difficult to schedule on a quick freezing processing basis. Two definite approaches are being made in The University of Texas laboratories at the present time to develop small adaptable low cost immersion freezers for locker storage plants that can be used to take care of the varying types of produce and fruits that normally the locker patron feels that he would like to have frozen. Not until sufficient adaptable equipment is made available can we recommend an extensive expansion of quick freezing of fruits and vegetables for the typical locker plant operator.

Refrigeration had its birth in the deep South and Southwest, and still has much to contribute in the rehabilitation of many rural and urban areas. Judicious and analytical examination should be made of an area before too much sentiment is aroused to promote and expand refrigeration facilities. Our community service should be established on basic investment principles and over-zealous patriotic sentiment should not be permitted to cloud the foresight and judgment of its citizens. This type of community development should be vested in active, alert business men who are interested in extending a service that will do the most good to the most people. It is not a service that would be promoted by outside dealers whose only interest is volume of equipment sales.

THE NECESSITY FOR THE CHICAGO DIVERSION

(Of 10,000 C. F. S., and How It Can Be Maintained With Equal Benefit to All Other Legitimate Interests.)

GEORGE G. EARL *

Probably the best approach to the consideration of the question of the Chicago Diversion is a brief historical review of the circumstances which have brought about its existing status.

This is given quite fully up to the end of 1924 in a report, dated January 23rd, 1925, by a Board of Review of twenty-eight members who were requested by the Chicago Sanitary District to study every phase of this problem and report fully any conclusions or recommendations resulting from such study.

I am placing a copy of this report in the Society Library in order that any one who desires to do so may follow through the full technical bases for their *unanimous* conclusions and recommendations.

The membership of this Board is given on the first page of this report; many of its members were men who were specialists in the lines of engineering under consideration and whose reputation stands very high in the profession.

Most briefly sketched historically:

In 1673 the French explorers Joliet and Marquette suggested the plan of reopening Lake Michigan's prehistoric outlet by a ship canal connecting it with the Illinois and Mississippi Rivers.

In 1808 the United States began the consideration of such a canal and a number of resolutions were passed concerning it, culminating in 1827 in a land grant to the State of Illinois authorizing and directing its construction by said state.

The State of Illinois (with a population of 157,000 in 1830), authorized the construction of this canal in 1836 and in 1848; after an expenditure of more than \$6,000,000, it was opened for navigation. Its only source of water supply was by diversion

* Life Member, Louisiana Engineering Society. Presented before the Society on March 11, 1940.

from Lake Michigan, part by gravity flow from the Calumet River and part by pumping from the Chicago River.

From 1861 on there were repeated recommendations for the enlargement of this canal, many of them by United States engineers.

The first sewers were built in Chicago in 1856 when its population was about 80,000; mostly these sewers discharged into the Chicago River; the water pumped into the canal from the Chicago River removed some of the sewage, but not enough to prevent the creation of very offensive conditions in the Chicago River.

In 1871 the canal was deepened to create a gravity diversion of 700 cubic feet per second, but the rapid growth of the city rendered this relief inadequate.

In 1897 a report by an engineering commission, composed of Rudolph Hering, Samuel G. Artingstall and Benezette Williams recommended the construction of a drainage and navigation canal with a capacity of 10,000 c. f. s. as sufficient to dilute the sewage of future human population of 2,500,000 at a rate of 4 c. f. s. per 1000 persons, and also sufficient to carry off the storm water drainage of its tributary area without any more flushing of the Chicago River sewage back into Lake Michigan.

At the date of this report Chicago's population was around 800,000 and its annual typhoid fever death rate was ranging around 79 per 100,000 (average from 1883 to 1892 inclusive). This frightful typhoid fever death rate was due mainly to sewage pollution of Chicago's water supply, and this pollution of Lake Michigan, which is the only possible source for a water supply for the Chicago center of population and industry, was brought about by the discharge of sewage either directly into the lake or into the sluggish Chicago River, where it deposited during dry weather and from which it was flushed out into Lake Michigan by every considerable storm.

An average of 739 deaths a year plus many times that number of serious illnesses from typhoid, plus a stinking river within its own boundaries, plus a stinking and utterly inadequate state water way connecting with the Illinois River at Utica, were considered sufficient cause by the City of Chicago and the State of Illinois to warrant the adoption and execution of this great

drainage and navigation canal as proposed in the 1887 report above outlined—so, in 1899, the Chicago Sanitary District was authorized by the State of Illinois to build a canal to carry 10,000 c. f. s. with a minimum bottom width of 160 feet, from the Chicago River to Lockport (28 miles) and work was started on its construction in 1892.

No one seems to have had any doubt at this time as to the right of the State of Illinois and the Sanitary District of Chicago to make any necessary diversion of water from Lake Michigan, or as to the approval of this enterprise by the United States.

With proper cooperation and encouragement by the United States, an adequate nine-foot waterway to the gulf could easily have been in full operation by 1910. Chicago was spending \$100,000,000 for its most costly link; the State of Illinois was committed to the expenditure of \$20,000,000 for its extension to Utica, Ill., where it entered the Illinois River, and, with a continuous flow of 10,000 c. f. s. a 9-foot navigable depth through the Illinois River only required the removal of several obsolete locks and dams between Utica and Grafton, where the Illinois River enters the Mississippi River. On the Mississippi River itself additional flow of 10,000 c. f. s. of relatively clear water from the Illinois River was of vital importance in increasing low water depth and maintaining proper navigable conditions from Grafton to Memphis.

The Chicago River however was under the jurisdiction of the Secretary of War and when, in 1896, Chicago asked his permission to widen and deepen its south branch so that it would have a capacity to pass 5000 c. f. s. at a one and one-quarter mile per hour velocity, he approved of the enlargement with the proviso that said approval should not be interpreted as authorizing Chicago to introduce *any* current into said river.

Again in 1899 when Chicago applied for permission to open the gates of the main canal and reverse the direction of flow of the main Chicago River, the Secretary of War gave the permit with a reservation of the right to either close or modify the discharge to any extent as may be demanded by navigation or property interests along the Chicago River. This permit further stated the intention of the Secretary of War to submit the ques-

tions connected with this diversion to Congress for consideration and final action.

At this time navigation interests and the existence of any current in the Chicago River were the excuse for withholding the full diversion and the Secretary of War finally settled down to a permit limit of an average of 4167 c. f. s. measured at Lockport, which held from March 31st, 1903, until after 1924.

Chicago, after a few years of experience of trying to maintain the average discharge at Lockport to nearly this limit, found that deposits of sewage were being formed everywhere in the drainage canal system and that the amount of dilution was not nearly enough to prevent most offensive conditions. Then, too, Chicago and her industries continued to grow and neglected to undertake steps toward sewage purification until long after the 2,500,000 human population equivalent of sewage was exceeded.

With an average of 10,000 c. f. s. continuous diversion, started in 1900, deposits would have been prevented for the most part, and there would have been adequate dilution to prevent objectionable conditions—until around 1913—so sewage purification, if progressively undertaken a little before 1913, could have maintained satisfactory conditions with the full diversion always continued.

Instead of permitting the full diversion and insisting that Chicago make it effective by proper steps, as they became necessary, in sewage purification, the United States joined with the Great Lakes States in seeking an injunction against the Chicago diversion. Chicago used only an annual average of from 2900 to 5116 c. f. s. from 1900 to 1907, then less than 7000 c. f. s. from 1908 to 1912, then an increasing amount reaching an annual average of 9465 c. f. s. in 1924 as one after another of its interceptors were brought into operation.

In 1910 a treaty with Canada as to the amount of water to be used for power at Niagara by the United States and Canada, as approved by the United States Senate, agreed upon 36,000 c. f. s. for Canada and only 20,000 c. f. s. for the United States because Secretary of State Root said the United States was using 10,000 c. f. s. at Chicago. This, while the permit of the Secretary of War was limited to 4167 c. f. s., and the actual use by Chicago was only 6833 c. f. s. in 1910. Secretary Root refused

to permit any mention of the question of the use of Lake Michigan water in this treaty, holding that this use of water from a wholly United States water shed and lake was entirely at the discretion of the United States.

The actual origin of the water on the whole Great Lakes water shed is about 60 per cent United States and 40 per cent Canadian, but assuming the continuous diversion of 10,000 c. f. s. at Chicago this treaty gave Canada 55 per cent and the United States only 45 per cent. So the Secretary of State and the United States Senate paid a very high price for something which the Secretary of War refused to permit.

With the continuous deepening of the outlet from Lake Huron without any effort to compensate for its increasing discharging capacity, there has been and under the same policy must continue to be progressive general lowering of the levels of Lakes Michigan and Huron; around two feet of such lowering effect occurred prior to 1891, years before the Chicago diversion was started, but the enemies of the diversion in the Great Lake States seized upon this issue and shouted "Water Thief" and "Draining the Lakes" and brought "Lake Levels" into this question with a violent propaganda campaign of the most false and misleading character.

No one who has given any fair study or consideration to this question will dispute the conclusion of the report made under a joint resolution of Congress by Col. J. G. Warren, after two years of thorough investigation of this subject.

According to this report, the effect of a reduction of 7000 c. f. s. as now required, would result in an increase of about one-third of a foot in the levels of the lakes below Superior. Incidentally, Col. Warren in this report recommended that the Sanitary District of Chicago "be permitted to divert from Lake Michigan and its tributaries a total quantity of water not exceeding at any time a flow of 10,000 c. f. s." But the Secretary of War and the Chief of the Army Engineers reported to Congress against this recommendation.

As long as the amount and duration of the Chicago diversion could be held in doubt so long (its enemies believed) it would be possible to prevent the development of any Lakes to Gulf Waterway.

However, somehow Col. W. V. Judson was directed to make a study of a 9-foot waterway on the Illinois River and reported in 1921 to the effect that "For a 9-foot channel, with an increment of 4167 c. f. s., the cost, either with dams retained or removed, appears almost prohibitive, and the probability that Congress will limit the increment to 4167 c. f. s. is, in my opinion, so remote that this hypothesis may be left out of consideration." Should Congress place the amount of water to be withdrawn from Lake Michigan at 10,000 c. f. s., which I deem probable, and under proper conditions advisable, that increment would increase the depth to 9 feet "with all dams removed."

This report seems to have been entirely ignored by the Secretary of War who was too busy trying to save one-third of a foot of Lake level lowering effect to bother about such questions; in fact he was so very enthusiastic that he even ignored an offer made by Chicago in 1918 to pay the cost of compensative works to be designed and built by the United States to overcome any lowering effect at all, which was, and still is, easily practicable at an insignificant cost.

The lower *lake levels* fell, the better the argument against the *diversion* if only the fallacy that these two had any relation to one another could be maintained.

Lake levels at any given point fluctuate rapidly with wind and barometric pressure, through a foot or two, and even in extreme cases, to a difference of level of 12 feet or more on the same lake. So, single readings mean nothing; average *monthly* elevations, however, taken by the United States Engineers, are a reliable index and, in the following, only such monthly averages are alluded to.

Monthly average lake levels of record from 1838 to 1938 have fluctuated through a range of 5.3 feet on Superior, 7.3 feet on Huron and Michigan, 5.5 feet on Erie and 6.2 feet on Ontario—an average of 6.3 feet for the five lakes.

Regulation at the outlet of Lake Superior has been in effect since 1916 but it was permitted to fall to an all time low level in 1926 when Lakes Michigan, Huron and Erie also attained their minimum to that date, leaving Ontario only with a higher minimum than that attained prior to 1900. Something just had to be done about Ontario, so on the next cycle, regulation of the out-

let from Superior was so used as to have just as much water in it at the end of the next long dry cycle as it had at its beginning. Nothing was taken from its storage, and so record low waters were produced around 1934 on both Erie and Ontario.

The combined genius of Canada and the United States has thus since 1916 given a record performance on how *not* to use water resources for the best good of all of our people. They have permitted Superior to fluctuate through a difference of level of three and one-half feet and the other lakes through a difference of level averaging 5.2 with Superior falling 2 feet and the other lakes an average of 3.6 below the minimum levels which could easily be maintained by the regulation of the output from lake to lake and the filling during wet cycles and regulated discharge during dry cycles of the 145 million acre feet of storage volume contained within a two and a half foot fluctuation of levels on the vast area of the Great Lakes, without any reduction of the necessary 10,000 c. f. s. diversion at Chicago.

Obviously if the long time average output from the Great Lakes is around 246,000 c. f. s. and we allow water to escape at a rate vastly in excess of this long time average supply before the lake levels have reached even the minimum level desired, and at higher and higher rates before the maximum desired storage volume is filled and still at rates above the long time average until it is emptied, we must expect the rapid lowering of levels and reduction of minimum output rate which are the inevitable result of this procedure at each recurring dry cycle.

Eighty-five per cent of the useful storage volume of the Great Lakes between desirable high and low water limits, is above the outlet of Lake Huron and it is the constantly increasing discharging capacity of this outlet which is responsible, mainly, for decreasing maximum and minimum and average levels on Lakes Michigan and Huron and for more violent fluctuations of level with lower minimum levels on Erie and Ontario.

The addition of a set of very low lift locks at the outlet of Lake Huron will permit of the regulation of its output. Regulation works already exist at the outlet of Superior. The last draft of the treaty prepared for the St. Lawrence sea way calls for regulation of the flow approaching Niagara and at the outlet of Ontario.

Such regulation works operated to fill and use the useful storage volume between any most desirable maximum and minimum elevations through a one and one-half foot fluctuation of levels on Lake Erie and a two and one-half foot fluctuation on the other lakes can guarantee *any* most desirable maximum and minimum lake levels, supply a 10,000 c. f. s. (or more if needed) diversion at Chicago and add one-third or more to the minimum output rates of record from Ontario.

It has been said that "Navigation will never stand for a lock" at the outlet of Lake Huron and Chicago's offer (made on the recommendation of the Board of Review in 1925) to bear its share of the cost of such regulation works was ignored by the United States.

The Secretary of War and the Great Lakes states continued their court fight against the diversion. The propaganda campaign which attributed lower and lower lake levels to the diversion was intensified.

Why navigation, which is supposed to desire a sea way with seventeen sets of locks between Montreal and Duluth with lifts of from twelve to forty-eight feet, cannot stand for one additional set of locks (which probably could be by-passed much of the time) with a lift of always less than four feet in order to prevent the objectionable low lake levels which were supposed to be so harmful to it, will be hard to explain.

It is still harder to see why, to avoid this one lock, Lakes to Gulf navigation should be penalized by several otherwise unnecessary locks at Chicago and below Utica on the Illinois River and the lack of any essential increment of flow necessary to maintain decent sanitary conditions for 160 miles from Chicago to Peoria, to maintain reliable 9 feet open navigable depth from Utica south, and even to assist in preventing salt water intrusion harmful to water supplies for industrial or domestic uses during extreme low water conditions in the lower Mississippi River.

There is no doubt but that the United States well knows what lake output regulations can do. The St. Lawrence sea way and power report to the United States Senate discussing the power question bemoans ice obstructions which reduce the winter output from Lake Ontario, when the power load will be greatest, says the proposed navigation improvements on the St. Lawrence

will overcome some of *this* difficulty (forgets to say that more winter output, when there is no navigation, means less flow during the navigation season under any possible condition) and adds that, in the future, *Regulations*, "in the interest of navigation," might increase the minimum winter output rate to 200,000 c. f. s. This can only mean, in the interest of navigation on the lakes and lake levels, since by no stretch of the imagination is it possible for a winter output increase from Lake Ontario to do anything but decrease the seven months' navigation season output to the St. Lawrence.

The conflicting navigation and power interests on the St. Lawrence can have a vastly increased minimum average annual output by proper regulation without any reduction of any desirable diversion at Chicago. Flows in excess of this annual minimum average would be mandatory to prevent higher lake levels than desired or could be permitted for a definite navigation season if compensated for by a lesser winter output.

At the inception of the Chicago diversion project St. Louis brought an injunction suit to prevent the discharge of this diversion and Chicago's sewage into the Illinois River watershed. In 1906 the United States court disposed of this injunction saying that the State of Illinois brought Chicago into the Mississippi watershed pursuant to acts of Congress of 1822 and 1827.

Decisions of the United States Supreme Court in 1925 and 1930 merely upheld the authority of the Secretary of War, in the absence of any action by Congress or authorization for a Lakes to Gulf Waterway by Congress. The injunction of 1925 was issued "without prejudice to any permit that may be issued by the Secretary of War according to law" and the Secretary then issued a temporary permit for a far larger amount of diversion than ever before.

The final decision of the United States Court of 1930 set a decreasing limit to the diversion with "an average of 1500 c. f. s. plus domestic pumpage" to take effect after 1938 ("*unless sufficient cause to the contrary is shown.*")

It is the "1500 c. f. s. plus domestic pumpage" which the last draft of the St. Lawrence Seaway treaty would fix without any recourse as the only diversion ever to be permitted from the Great Lakes watershed.

It was shortly after the decision of 1930 that Congress authorized the taking over and completion of the Illinois State water way, and the undertaking of the improvement of the Illinois River to provide a 9-foot waterway to the Mississippi River, including the limitation that this authorization should not include any authorization for any diversion from Lake Michigan.

So at last a Lake to Gulf waterway was authorized, but with a decreasing diversion limited to an average of 1500 c. f. s. plus domestic pumpage after 1938 (unless sufficient cause to the contrary is shown) which means that during dry weather Chicago's purified sewage—plus or minus whatever margin remains after the storm water drainage of the Chicago center has been accounted for, will be available to aid low water navigation say 2,000 c. f. s. (more or less) three-quarters or more of which is Chicago's 70 per cent (more or less) purified sewage.

New Orleans and other cities en route celebrated the opening of this so called waterway for use in 1933.

At a hearing in Congress in the winter of 1938 on the Parson's bill, which would authorize an average of 5,000 c. f. s. *withdrawal* of lake water to aid navigation, General Ashburn, then the head of the United States Barge Line Service, and Mr. Ingersoll, the head of a large privately owned barge line using this waterway from Cairo to Chicago, both testified as to the need of this additional water to maintain a 9-foot waterway and as to numerous groundings of underloaded barges at low water seasons.

As to the sanitary condition, even with an average of a 5,000 c. f. s. plus domestic pumpage, then in effect, Mr. Ingersoll said the conditions from Peoria to Chicago were awful, that his crews had to wear rubber gloves and to have the strongest disinfectant at hand to prevent loathsome infections if any one touched this water, especially if with an abrasion. Mr. Ingersoll said, "If the diversion is reduced to 1,500 c. f. s. after 1938, you will have the most ungodly stinking mess of sewage from Chicago to Peoria (160 miles) that you could find anywhere in the United States."

Gen. Ashburn, who listened to Mr. Ingersoll's testimony, followed him on the witness stand and disposed of the question of

the sanitary condition of this waterway by saying that he was in full agreement with Mr. Ingersoll's testimony in this connection and urged the necessity for the full 10,000 c. f. s. diversion to maintain 9-foot navigable depth all the way to Cairo, Ill.

It is universal experience that slack water systems receiving organic wastes where there is not enough low water flow to maintain said wastes in suspension and moving, and to provide enough dissolved oxygen to prevent their septic decomposition, accumulate deposits and become unfit for use, and one of the objects to be attained by storage reservoirs in many cases is the supplying of enough low water flow to prevent this condition from arising.

"Purified" sewage still carries a large oxygen demand depending upon the percentage of purification attained. If the dry weather sewage of the Chicago center representing an equivalent population of over six million (including industrial wastes) is all 70 per cent purified, it would still call for a dilution at least as great as would be required for an equivalent population of 1,800,000 without purification. Since storm flows carry great quantities of entirely unpurified sewage from which, without the full diversion constantly in effect, the organic wastes are deposited wherever they happen to be when the current slackens and since these same conditions apply to the wastes from other industrial cities on the Illinois River where large quantities of water are required from it for industrial uses and where liquid, human and industrial wastes have no other possible outlet, it is very clear that nothing less than the full diversion contemplated and recommended by the Hering Commission in 1887 will suffice to create tolerable conditions in the series of pools which now exist all the way from Chicago to Alton on the Mississippi River.

The expenditures which have been made in unnecessary locks, dams, etc., below Utica to force a reduction of the diversion and gain a nominal lifting of lake levels of one-third of a foot (which no one will ever recognize) if applied to regulation of the output flow from Lake Huron could have eliminated all questions as to lake levels without any reduction of the diversion and given a decent and effective Lake to Gulf waterway.

The average annual output from the American Lake Michigan is over 50,000 c. f. s. For the Great Lake States or Canada, and especially New York State, to claim that every drop of water which naturally drains toward Lake Michigan must find its natural outlet through the St. Lawrence is preposterous.

Canada proposes to bring additional water into the Great Lakes system and hold it for its own exclusive use. How about the other watersheds which *she* is robbing? New York City, after years of litigation, is impounding Delaware River water for a very large addition to her water supply. Should not this water *belong* for power navigation and water supply to New Jersey, Pennsylvania and Delaware?

Colorado is holding out a large amount of Colorado River water and sending it across the Continental Divide through a tunnel for water supply and irrigation on an entirely different watershed.

Then, at Boulder Dam, 14 million acre feet of useful storage is to provide power and water supply and irrigation mostly to Southern California, which state contributes no part of the water impounded by said dam, but the Colorado River naturally discharges through Mexico into the Gulf of California. Why has not Mexico as much right as Canada or New York State to insist that all of the water shall find *its* natural outlet?

The expenditure of millions on millions of dollars all over the United States to create a few thousand or a few millions acre feet of useful storage of water in very costly artificial reservoirs may be justifiable in most instances, but one thing we should remember, many of these artificial reservoirs will fill up more or less rapidly with deposits; they are in that sense natural resources which are being used up.

Large natural lakes for such fluctuation of level as is tolerable or desirable in them can have their discharge regulated and give out their stored volume at an infinitely lower first cost and such use of such natural lakes neither starts nor accelerates the process of filling up with sediment which of course is always more or less in effect in all reservoirs or lakes.

There is probably no other spot on earth where so much storage can be *filled* and *used* at so low a first cost per million acre feet or to so great an advantage to so many people as this

145 million acre feet on these Great Lakes between desirable maximum and minimum levels (only about half of their natural fluctuation as of record between 1929 and 1934 for the lakes below Superior.)

The last draft for the proposed St. Lawrence Seaway and Power Treaty disclaimed any impairment or infringement of United States sovereignty over Lake Michigan, but "*because of the great interest of the high contracting parties in the preservation of the levels of the Great Lakes System,*" it agreed that no other diversion shall *ever* be made from the Great Lakes watershed (including Lake Michigan) and that the Chicago diversion after 1938 shall be reduced to 1,500 c. f. s. plus domestic pumpage, claiming (falsely) that this is in accord with a United States Supreme Court decision.

The United States Supreme Court decision was not a final decision but merely a limitation in support of the authority of the Secretary of War, in the absence of any authorization by Congress for a greater diversion or for a Lakes to Gulf waterway and was itself limited by the clause "*unless sufficient cause to the contrary is shown.*"

The treaty is intended to indicate to the people that the matter had been finally settled by the court and that the reduction of 7,000 c. f. s. in the Chicago diversion would be a complete cure for all lake level troubles. Its authors, and all informed persons, well know that this reduction in the Chicago diversion, under present discharge conditions, can only make one-third of a foot increase of lake levels, which have fluctuated through an average range of over five feet on the four lakes below Superior since 1924; that this fluctuation is twice as great as is desirable, and that the minimum levels attained on all of these lakes were at least two feet and probably three and one-half feet lower than a desirable minimum.

The treaty gives no limit, high or low, or range through which the International Commission may cause or permit Lake levels to fluctuate, but agrees that the output from Ontario, i. e., from the whole Great Lake System, shall be regulated so that *existing levels at Montreal* shall be maintained regardless of dredging and enlargement of channel below Montreal.

The maintenance of such levels at Montreal is impossible unless compensating works (not stipulated in the treaty) are provided in the lower portion of the St. Lawrence River. The deepening of the outlet of Huron called for by this treaty and additional channels permitted by the treaty can easily cause far lower minimum lake levels than those of record, unless compensation or regulation works are provided at this point. The United States or Canada, or both, have refused to provide, or permit either, even when Chicago offered to bear all of the cost of compensating works in 1918, or its share of the cost of regulation works in 1925. Obviously the "great interest in the maintenance of the levels of the Great Lakes Systems" by the two governments which have this record behind them means nothing as to lake levels when it promises an impossibility as to maintaining existing levels at Montreal, and makes no promise at all as to any limitation upon future fluctuation of levels on any of the lakes, proposes the reduction of necessary diversion by 7,000 c. f. s. with a one-third of a foot possible plus, and the deepening of the outlet of Huron with a very much larger possible minus, to cure a three and one-third foot (or even a two-foot) minus in minimum lake levels of recent record.

The people of the Interior have helped to pay for Great Lakes and Seaboard and Panama Canal and all other river and harbor improvements which as a whole have been operated mainly to their detriment—while they have had to pay exorbitant and ever increasing railroad freight rates which, in part because of their exorbitance, have aggregated less and less until the railroads were as badly off as the people in the areas which they served.

The saving in transportation costs which can be effected by properly organized barge fleet transportation, including common carrier service on our inland waterways, constitutes one of the main hopes for the great interior of our country to progress in such industrial development as is essential for the creation of a home market for our products and an opportunity for local employment for our people.

The St. Lawrence Seaway and Power Report to the United States Senate speaks of a large area of the United States and percentage of its population as a "St. Lawrence tributary area," and the dominating interests in the Great Lakes states have con-

sidered most of the interior and the South in this light, and by one means or another had managed exploitation by 1929 to a point where there was no purchasing power left to support their cast industries or debt paying ability to service their investments in these "Tributary" areas.

The forty-four-year fight against the full necessary Chicago diversion has been made and is still persisted in, solely to prevent the development of effective inland water transportation and competitive local industry.

All Secretaries of War and the dominating majorities in Congress seem to have felt it best to concentrate industry and power on the Great Lakes and Sea Boards, and this concentration has taken a larger and larger share of a lesser and lesser earning power from these tributary populations until there was nothing more worth taking.

The only hope for general prosperity lies, not in such exploitation, but in cooperation. We must obtain the widest possible dispersal of small industries, home owned and operated with the full utilization and conservation of our natural resources everywhere and the most economical transportation for the interchange of the products of both farm and factory and, especially for our water resources, their utilization for the greatest good of all of our people.

Discussion

BY JOHN KLOSER.*

Mr. President and Members:

Mr. Earl has addressed you on the desirability as well as the necessity for a diversion of 10,000 cubic feet per second of water from Lake Michigan into the Illinois Waterway.

Mr. Earl is well informed on the subject he discusses. For the information of the younger members of the Society, it should be told that he was a member of a committee of 28 engineers appointed in 1925 to make a study of the lowering of lake levels in the Great Lakes, and to submit a plan of remedial measures. I wish to say something about that committee, because while Mr. Earl has told you he has placed a

* Life Member, Louisiana Engineering Society.

copy of the Report in the Library of the Society, you may not have the opportunity or time to look it over. On that committee were some of the most eminent men in the profession. You will recall their names as being those of leaders in engineering thought and accomplishments. They included John R. Freeman, Carl Grunsky, Harrison Eddy, Arthur E. Morgan, Morris Knowles, George Fuller, and others not so universally known, perhaps, but all capable men. All sections of the country were represented in the personnel of this committee. The Great Lakes were represented by 11 men of this committee.

It is doubtful if ever there was assembled a more representative or talented group of engineers to make a study of an engineering problem which appeared to be highly controversial at the time due to misleading propaganda, and which problem was pressing for a correct, honest, and intelligent solution.

Navigation interests on the Great Lakes and those on the Mississippi River and its tributaries were involved; sanitation interests in Chicago, and in some of the down-stream cities on the Illinois River and the Mississippi River were involved; hydro-electric generating companies on the Niagara river were involved. The preservation of the scenic value of Niagara Falls was involved.

This fact-finding committee, after an exhaustive study, and after due deliberation, submitted its report. One of the impressive features of this report, aside from its technical value, was the fact that it was unanimous in its conclusions. Not one of these twenty-eight engineers availed himself of the privilege of submitting a minority report on any of the various phases considered.

In so far as the lowering of lake levels of Lake Michigan was concerned, which was blamed on the Chicago Diversion, the committee reported that several factors were responsible for this and stated that the greatest factor was the variation from year to year in the natural climatic conditions chiefly rainfall and evaporation, and was not due to the diversion of water from Lake Michigan, the lowering effect of which was negligible, not exceeding five inches in twenty-five years.

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The committee recommended control works at the outlets of Lakes Erie and Huron, supplementing the existing works of that character at the outlet of Lake Superior, and which were within practical and justifiable limits of cost, and would add two feet or more to the minimum depth then available in the Great Lakes harbors and channels.

The report of the committee stated:

“Control works are necessary for the best utilization of the lakes for navigation, power and scenic effect, regardless of whether or not diversions are made for the Chicago, the Welland, or the Erie Canals. They could maintain the levels as high with the diversions continued as with them stopped; and their cost would be but slightly affected by the diversion of 10,000 cu. ft. per second at Chicago.” And, as was pointed out by Mr. Earl in his statement, even the 10,000 cu. ft. diversion could be increased without causing any unfavorable conditions to the other interests.

The recommendations of this committee are as logical and as engineeringly correct today as they were in 1925. They have never been assailed or questioned by any reputable engineering authority. Yet, it seems impossible to have them put into effect. If they had been, or if they were even now carried out, there would be a much improved condition as regards sanitation in Chicago and vicinity; there would be better navigation conditions between Cairo, Ill., and Chicago, via the Mississippi River; there would be a more dependable and more uniform flow for Niagara Falls, and for the power interests on the Niagara River.

It is a sad commentary on our civilization that primitive, shall I say, savage, emotions stand in the way of the accomplishment of a great enterprise for the common good of the country as a whole. We see jealousy on the part of the Great Lakes Navigation interests manifested towards the development of a Lakes to the Gulf Waterway, which is a project of great potential value to the Mississippi Valley; we see envy on the part of the municipalities on the Great Lakes shown toward the ascendancy of Chicago to the place of leadership, and an opposition towards anything that might make for a greater Chicago. We see greed on the part of the power in-



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terests for the utilization of every possible cubic foot of Great Lakes water to turn the turbines in the hydro-electric plants on the Niagara River. We see waste, legalized, enforced, official waste of public funds.

The United States engineer who in 1933 prepared the plans for a nine-foot channel 300 feet wide for the Illinois River below Lockport was *directed* to so plan the project "as to require the smallest flow of water with which the said project can be practically accomplished in the development of a commercially useful waterway and within the limitation of the quantity of diversion as stipulated by the United States Supreme Court degree of 1930, viz., 1,500 cubic feet per second plus domestic pumpage." Those were his orders. Being a soldier as well as an engineer, the orders of his superiors were carried out.

It mattered not in this instance that the estimated cost of such channel improvement utilizing a diversion of 1,500 second feet and with necessary locks amounted to 12 million dollars; while, on the other hand, the cost of an equivalent channel utilizing 9,000 second feet diversion and requiring no locks was only two and one-half million dollars. The difference in these two estimated costs for channel improvement was more than sufficient to pay for the regulatory control works at the outlet of Lake Huron that would have provided two (2) additional feet, or more, to lake levels. And the irony of it is that this expenditure was made in the attempt to recapture the 5" lowering of lake levels attributed to the Chicago Diversion by throttling it down to 1,500 cubic feet per second. Moreover, the estimated cost of maintenance and operations for the 1,500 second feet diversion plan was \$100,000 per year more than for the 9,000 second feet diversion plan.

In the consideration of these respective plans, tell me, what had become of the cornerstone principle so uniformly and consistently applied in the making of recommendations by the United States Engineer Department, namely, "economical justification for the expenditure."

That 10,000 second feet of diversion would have done more than dilute the sewage effluent of Chicago. It would have added one-fourth to the low water flow of the Mississippi at St. Louis. It would have added one-seventh to the low water flow of the

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Mississippi River at Cairo. These added flows would have facilitated and no doubt permitted uninterrupted movement of the barge traffic from the Mississippi River to Chicago, and would have obviated the numerous groundings of barges that were loaded to less than economical carrying capacity which was referred to by Mr. Earl, and testified to by Gen. Ashburn and others before the Congressional Committee.

What is there to do under the circumstances? No encouragement is offered by way of Congressional enactment. Two years ago, Mississippi Valley interests and Chicago interests endeavored to have Congress pass a bill authorizing the withdrawal of 5,000 second feet from Lake Michigan. This was the Parson's Bill. Hearings were conducted before the Rivers and Harbors Committee of the House. Representatives from the Valley considered they had made a good case. But the bill was not even reported out of the committee, of which Mr. Parsons himself was a member.

As I see it, the only hope for a greater diversion from Lake Michigan will come as a result of intolerable sanitary conditions in the Illinois Waterway System that bids fair to become progressively worse as time goes on. When the nuisance has reached the limit of human endurance, the 1,500 second feet limitation Supreme Court decree will be thrown to the winds and a menacing condition to the health of a populous area will be corrected. I believe this is the unexpressed view and hope of the United States engineers who have had charge of the Illinois Waterway Improvement.

In fairness to Lt. Col. Dan I. Sultan, United States District Engineer for the First Chicago District, who prepared the plan for the slack water navigation project in accordance with the requirement of the Rivers and Harbors Act of 1930, it must be stated that he pointed out in no uncertain language the probable unsanitary condition likely to develop in the various pools of the Illinois waterway, and which has been referred to by Mr. Earl.

I quote from Col. Sultan's report:

"The determination by the Supreme Court of the amount of water to be diverted at Lockport was based upon the requirements of navigation in the Port of Chicago and connecting chan-

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nels. There is no difference between the requirements of navigation on the Illinois River and waterway and those of navigation in the Port of Chicago. Conditions of health safety and efficiency should be satisfactory for all. A reasonable standard of healthful and decent living conditions for those aboard ships and working at terminals on shore must be maintained. Injury to navigation may occur if putrefaction in the water results in nauseous and disgusting conditions. Such a condition may be caused by the putrefaction of the effluent from the sewage treatment plants, putrefaction of raw sewage contained in storm water run-off, and putrefaction from accumulated sludge deposits. The weight of expert testimony is to the effect that the effluent from proposed activated sludge treatment plants will be inoffensive, but the sanitary district program of treatment is on such an unprecedented scale that such predictions must contain some element of uncertainty. No reliable process of calculation can predict the effect of raw sewage in storm water run-off and of accumulated sludge deposits. After intensive and prolonged study based upon the testimony of a number of eminent sanitary engineers, Special Master Hughes reached the conclusion that these matters were indeterminate.

"No one can predict with certainty the effect in 1939 of the reduction of diversion upon navigation below Lockport at any time prior to the completion of the sewage treatment program. Sound procedure would be to carry out the full program of treatment plant construction, reduce diversion as required by Supreme Court decree, and observe its effect."

In conclusion, I wish to say I was very pleased to learn that Mr. Earl had prepared the paper he delivered tonight. It contains much wisdom and information compressed in small space. It deals with a subject that should command the interest of everyone living in the Mississippi Valley. It describes a colossal and indefensible national blunder that has kept every legitimate interest involved from participating in mutual benefits on a large scale, and the United States Congress has done this in spite of the very best engineering advice obtainable.

A person listening to Mr. Earl's paper probably missed half of what a careful reading would disclose. The paper unquestionably deserves publication in our Journal.

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MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Society, March 11, 1940

The meeting was called to order by President Rhodes with approximately 110 members and guests present.

Mr. Charles Kerr presented an obituary on Floyd Hamilton. Prof. Ricker presented an obituary on James M. Robert, Jr. It was moved that both these documents be incorporated in these minutes, and copies sent to the respective families.

President Rhodes announced the formation of the Mississippi Engineering Society, with 250 present at the first meeting.

It was announced that the next meeting of the Society would be held jointly with the American Society of Mechanical Engineers. Dean Woolrich will deliver a paper on "Quick Freezing of Foods." Wives of members will be invited to attend.

Chairman Stewart of the Membership Committee Division "A" appealed to those present to bring in desirable members, and announced the number either elected or in the process of election since January 1, 1940.

Mr. Karl Kammer announced the party being given by the Auxiliary on March 16 at the Southern Yacht Club. He promised that a good time would be had by all attending.

An invitation was presented from the Society of Military Engineers to hear a paper to be presented by Commander Vanzant on March 18,

Mr. George G. Earl was then introduced. He read a very interesting paper on "Ten Thousand Second Feet Diversion at Chicago, and How It Can Be Maintained to the Equal Benefit of All Legitimate Interests."

Mr. John Klorer presented a supplementary paper in a very forceful manner.

Mr. O'Neill moved, and it was approved, that the President appoint a committee to draw up a resolution and submit it to the membership. This resolution would urge the increase of water diversion at Chicago.

After a rising vote of thanks to the speakers, the meeting adjourned to the colation.

A. M. HILL, Secretary-Treasurer.

JAMES MARSHALL ROBERT, JR.

James Marshall Robert, Jr., passed away in his native city of New Orleans on March 6, 1940.

Born June 5, 1911, James M. Robert, Jr., son of James Marshall Robert and Gladys Kearny Robert, received his early education at Isidore Newman Manual Training School. He was graduated from the College of Engineering, Tulane University, June, 1931, receiving the degree of Bachelor of Engineering in the Mechanical-Electrical course. The following school year he entered the Tulane College of Law, receiving the degree of Bachelor of Laws in 1934.

During his college career he was a member of the Pi Kappa Alpha social fraternity, was elected to membership in Omicron Delta Kappa leadership fraternity, Phi Phi and Kappa Delta Phi

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honorary fraternities. He served as editor of the Jambalaya, as a member of the Tulane Law Review staff, and was President of his senior law class. In 1938 he was elected to membership in Tau Beta Pi, honorary engineering fraternity.

Upon graduation he helped form the law firm of McCloskey, Moore, Morrow and Robert and was admitted to the Louisiana Bar Association in 1935. He maintained the above connection until 1936, when he joined the legal staff of the New Orleans Public Service Inc.

His engaging personality and unquestioned loyalty and ability won the sincere esteem and respect of his many friends and associates in the business and social worlds.

James Marshall Robert, Jr., maintained active membership in the Louisiana Engineering Society since joining as a student member in 1930. The Society recognizing its own loss in no small degree, extends sincere sympathy to his family in their great bereavement.

Therefore, Be It Resolved, That the above record of a faithful and loyal member be spread upon the minutes and published in the Proceedings of the Louisiana Engineering Society, and that the saddened thoughts of his fellow members be conveyed to his family through the medium of this resolution.

A. LEE DUNLAP,
K. P. KAMMER,
C. W. RICKER.

MEMOIRS

FLOYD HAMILTON

Died November 8th, 1939

Floyd Hamilton, the youngest son of Isaac and Lydia Simons Hamilton, was born on July 3, 1884, at Ten Mile, in what is now known as Allen Parish, Louisiana.

His early years were spent upon the homestead farm and he received his preparatory education in the local community schools.

In 1905 he matriculated in Louisiana State University, after having taught in the rural schools of what was then called Calcasieu Parish, and graduated in 1909 with the degree of bachelor of science in the School of Engineering, and in 1932 he received the degree of Civil Engineer from his Alma Mater in recognition of his achievements in the field of his chosen profession.

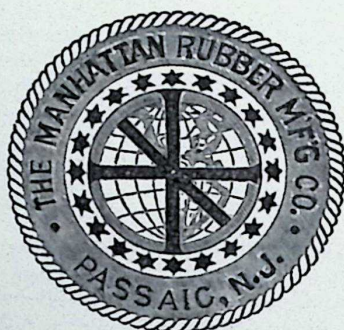
While attending the University he took an active interest in college affairs, serving at different times as President of the Young Men's Christian Association and Drum Major. He was awarded the Garig medal for public speaking when a member of the intercollegiate debating team during his senior year. In that year he served as student instructor in Civil Engineering.

Subsequent to his graduation, he taught in the Oakdale High School, serving as principal for the last three years of his tutorship. At the same time, he acted as secretary to the Town Council, and was elected a delegate to the Calcasieu Parish Division Assembly, and in 1912 when the parish was subdivided into Allen, Beauregard, Jefferson Davis and Calcasieu, he was a motivating spirit.

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In 1912 Mr. Hamilton was elected as the first clerk of the newly created Parish of Allen, and in 1913, Governor Luther Hall appointed him the first Parish Surveyor.

In November, 1913, Mr. Hamilton moved to the City of Lake Charles, where he assumed the duties of location and construction engineer of the Parish of Calcasieu. In 1917, he was made Parish Engineer of the Parishes of Allen and Calcasieu, serving in that capacity until 1920, at which time he entered the employ of the Louisiana State Highway Commission, in which service he remained until his death.

Outside of his professional duties, Mr. Hamilton devoted much time and effort in civic, public and religious activities. He was elected a member of the City School Board of Lake Charles in 1922 and served as President from 1924 to 1931. He was actively interested in educational work and served as Vice-President of the Louisiana Association of School Board Members in 1938.

Mr. Hamilton was a member of the Baptist Church, serving for years in various official capacities in his community.

Mr. Hamilton enjoyed an enviable reputation among members of his profession and was known as a capable engineer of the highest integrity; the public whom he served regarded him as a trustworthy official; his associates knew him as a constant and loyal friend.

On July 18, 1912, he was married to Madeline Hewitt, the eldest daughter of Mr. and Mrs. Z. M. Hewitt. He is survived by Mrs. Hamilton and four children, who are Lydia, Blanche and Isaac Madison Hamilton of Lake Charles, La.; Randall Hewitt Hamilton of Port Neches, Tex., and a grandchild, Randall Hewitt Hamilton II, of Port Neches, Tex.

Mr. Hamilton was elected a member of the Louisiana Engineering Society in June, 1919. He was a member of the Phi Kappa Phi honorary scholastic fraternity, of the Louisiana Association of School Board Members and of the Baptist Church.

CHARLES M. KERR, Chairman,
W. H. RHODES,
DAVID W. GODAT.

Minutes of the Board of Direction, March 29, 1940.

The meeting was called to order by President Rhodes with the following members present: Barnett, Godat, Nelson, Ricker, Hill, and C. C. Barnard by invitation.

Minutes of the previous meeting were read and approved.

Mr. Barnard outlined briefly some of the aims and improvements in connection with the proposed Union Station. A resolution was adopted by the Board to be presented to Mr. Godat in Monday's meeting (April 8).

A resolution recommending the introduction of the Engineers' licensing law into the coming legislature was adopted by the Board.

It was agreed to circularize the members of the Board with the material on activities of the American Engineering Council.

President Rhodes outlined the program to be presented at the Baton Rouge meeting on Friday, May 10.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

JUNE, 1940

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The Secretary was directed to write A. E. C. about H. R. Bill 960, concerning extension of Civil Service. The bill will be referred to the Public Relations Committee for their study and recommendation.

There being no further business, the meeting adjourned.

A. M. HILL, Secretary-Treasurer.

**Minutes of the Joint Meeting of the Society with the A. S. M. E. on
April 8, 1940.**

First Vice-president Nelson called the meeting to order with approximately 225 members and guests present.

The reading of the minutes of the last meeting was dispensed with.

Announcements were made concerning the Baton Rouge Meeting on May 10, and about a meeting of A. S. C. E.

Mr. Godat presented a resolution concerning the proposed Union Station, which resolution was approved by those present and is appended to the minutes of this meeting.

Chairman Bedell of the Legislative Committee introduced the resolution concerning the bill for the licensing of professional engineers. A copy of this resolution was mailed to each member at the time the April meeting was announced. The resolution was adopted with no dissenting vote.

Chairman Ole K. Olsen of the Entertainment and Outing Committee announced that the annual golf tournament would be given in June.

First Vice-president Nelson then turned the meeting over to Chairman Kammer, A. S. M. E. He introduced Dean W. R. Woolrich, University of Texas, who spoke on "Recent Developments in Quick Freezing Methods." He showed slides illustrating various points mentioned in his talk. Numerous questions followed.

Mr. Warren H. McBryde, President of A. S. M. E., was next introduced, and made a brief address.

The meeting then adjourned to the collation.

A. M. HILL, Secretary-Treasurer.

ACTIVITIES OF LOCAL SECTIONS

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STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

Special Meetings at
call of President

With this issue the page devoted to activities of the Louisiana Section, American Society of Civil Engineers, will be discontinued, and in its place will be substituted the LASEC NEWS.

At the last meeting of the Section held on April 29th it was voted to continue LASEC NEWS in conjunction with the Louisiana Engineering Society Proceedings. This will be accomplished by printing LASEC NEWS as a supplement to, and bound with PROCEEDINGS, thus placing the Section publication on a permanent basis and in printed form instead of mimeographed as heretofore.

To those members of the Section who are not members of the Louisiana Engineering Society will go reprints. Thus every member of the Section will receive a copy either in full with the PROCEEDINGS or as a reprint under separate cover. It is the desire of the Publicity Committee that in its new form LASEC NEWS will merit the earnest and continued support of the Section.

At the first Annual Forum of the Tulane Student Engineering Societies the paper presented by Mr. W. F. Tompkins, Jr., of the Student Chapter, ASCE, was awarded first prize. On May 10th the College of Engineering held its annual Field Day, at which time the Student Chapter, ASCE, its founder, participated with various exhibits in the Civil Engineering Drafting Room. Mr. William R. Burk, Jr., was elected President of the Student Chapter, ASCE, for the year 1940-41.

On May 10th the Student Chapter, ASCE, at Louisiana State University participated in the Annual Engineering Day exercises with various exhibits and assisted in acting as hosts to the Baton Rouge meeting of the Louisiana Engineering Society.

THE PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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JAMES M. ROBERT, Editor.

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The last name on each committee is the Junior member, who sits with the committee, but without vote.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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EDITORIAL NOTES AND COMMENT

LASEC NEWS. We welcome to these pages the LASEC NEWS. We won't steal their thunder. Turn to the title page of LASEC NEWS and read for yourself. This is merely a note of cordial welcome. This is another step toward the solidarity of the engineering profession. May there be many more!

Death of Wade Barnett. With poignant regret we note here the death of Wade Barnett. He was a life member of the Society, having joined it in 1910. His quiet and simple dignity

and his self-effacing friendliness earned for him the profound respect of all who were fortunate enough to know him.

Technically, too, the community has suffered a great loss. His work was his great interest. The community has lost an ardent worker, the profession has lost an accomplished engineer, and his friends have lost a truly lovable friend.

Our Custom of Joint Meetings. Some years ago the Louisiana Engineering Society instituted the custom of devoting certain of its meetings to other engineering organizations, such meetings of our Society to be held under the auspices of those organizations. A glance backward will show this was both a wise and valuable institution.

The meetings which have been held under the auspices of local sections of national engineering societies have done much to consolidate and cement all engineering interest (at least locally).

These meetings have helped greatly to impress upon us that we are all members of a single profession—and it should be thus—rather than members of specialized groups with little interest in other specialized groups or in the profession as a whole.

These meetings are valuable, too, in widening our personal contacts in the profession. It is true that if we are working with a specialized group most of our personal contacts are with other members of the same group. These joint meetings give opportunity to meet members of other specialized groups whom we do not see so frequently in our regular line of work.

We know pretty well the reactions of individuals in our own line of endeavor. It is always interesting and refreshing to learn by personal contact the views and reactions of those in the same general profession whom we do not see so often in our daily work.

May these joint meetings continue and be frequent!

Farewell Dinner for Colonel Tompkins. On July 10 a farewell dinner was held at the St. Charles Hotel for Lt. Col.

William F. Tompkins, U. S. Engineers, District Engineer, Second New Orleans District.

Upon the occasion of his being ordered to a new post, Col. Tompkins' many friends in the Louisiana Engineering Society and the American Society of Civil Engineers wished to join him in a last "get together." Messrs. Ole K. Olsen and Horace A. Thompson did the hard work of managing what was a very successful affair.

Lt. Col. Tompkins through a combination of sheer ability and genial good nature has endeared himself to all with whom he came in contact. No proposition was too small to receive his cheerful attention, and no situation was too large for him to handle in a thoroughly masterly fashion. The host of his friends regret to see him leave. We shall miss you much, Colonel Tompkins.

The Golf Tournament. The Golf Tournament which is a golf tournament, horse-shoe contest, and smoker combined, was held on June 20 at the Metairie Country Club. What an event it was! It always is!

Attendance reached the high figure of 110 members and guests.

Tribute must be paid to the hard working committee on two counts: first, a grand program of fun and entertainment; secondly, the cost thereof was under the budget. This cutting of corners without cutting quality always means hard work coupled with good management. Our hats are off to you, Dave Stewart, and your Committee.

And another thing: Don't forget that for years our own Great Dane, Ole K. Olsen, has furnished beer on the greens. One never knows in just what new spot Ole will break out, but whenever he does it is always in the interest of good fellowship and good sportsmanship.

This year, too, the long list of prizes was augmented by the handsome trophy donated by the New Orleans Public Service.

The Airplane in Modern Warfare. A succinct, informative and interesting article on a very timely topic is carried in this issue under the above caption.

General Martin has put in few words and clear fashion information which we should all read. Moreover, it is not at all dull reading—in fact quite the contrary.

Fundamentals of Acoustics. The discussion by Mr. Gerald C. Kerr which appears in this issue calls to mind a very urgent present day necessity—namely, the necessity for as much noise abatement as possible.

His paper points out some simple fundamentals which we all should know concerning noise, its measurement and its abatement.

PAPERS AND DISCUSSIONS

THE AIRPLANE IN MODERN WARFARE

By F. L. MARTIN *

Read before the Society July 8, 1940.

History is replete with the changes that have been made in tactical dispositions in military forces by improvements in military weapons. Man, being a member of the animal kingdom, has been forced to fight for an existence, but due to his superior intelligence over other animals, has devised ways and means of utilizing weapons for his protection and success in his conquests. Primeval man utilized sticks and stones for many hundreds of years before his ingenuity developed the bow and arrow.

The first great advance in modern weapons occurred when the English adopted the long bow, which was used to give them the advantage on the battlefield of Crecy. Gunpowder was known for many, many years before it was successfully utilized in firearms in the hands of military forces. Since that time constant improvements have been made in the manufacture of gunpowder and in modern firearms in which it is used. The advent of the steamboat played its part in the evolution of naval activities. Tremendous strides were made in increasing naval power by the adoption of armored plate for the protection of naval vessels as the result of the battle between the Monitor and Merrimac on March 9, 1862.

In modern times our tactical dispositions have been influenced by the advent of the telegraph, telephone, radio and motor vehicle; which have materially speeded up the transmission of messages, having a direct effect upon speed in carrying out of military dispositions. The submarine passed through a long era of experimentation before it proved of sufficient success to be adopted by modern navies, but it was years after the submarine had been accepted as an auxiliary in all modern navy forces before it was utilized as an outstanding factor in naval warfare by the Germans in the first World War.

Tanks, which are nothing more than miniature land battle-ships, were first used extensively in military operations by the British in their attack against the Germans on the Somme,

* Brigadier General, Air Corps, U. S. Army, commanding Third Wing G. H. Q. Air Force, Barksdale Field.

September 15, 1916. It was also during the World War that chemical agents were first employed as a military weapon.

In each case the advent of improved military weapons, due to their element of surprise, has given temporary advantage to the nation by which employed. The effect of this advantage is of short duration, for there always can be developed a successful defense for the advantages accruing to new offensive weapons.

While the first flight by man in a heavier-than-air airplane was made by Orville Wright on December 17, 1903, the airplane did not receive serious consideration as a military weapon until during the World War, from 1914 to 1918. Then at first it was used entirely for the purpose of gaining a point of vantage for observing the movements and dispositions of the enemy. It was not until some enthusiastic aviator conceived the idea of using the rifle for the purpose of attacking enemy observation planes that serious consideration was given to the placing of armament on military airplanes. It seems most unfortunate that such a pleasant pastime should have been made so hazardous. The first bombs dropped from military airplanes were carried aloft to be chucked over the side when the pilot thought he had an opportunity of destroying some objective on the ground of military value. This was the genesis of our scurrying, like chickens from a hawk, when enemy airplanes are overhead.

Great impetus to the use of the airplane as a military weapon was engendered under the pressure of conflict in the World War. Upon conclusion of World War No. 1 all nations of the civilized world recognized in the airplane a military weapon of tremendous possibilities as an aid in the furtherance of military endeavor. The clamor was for speed and more speed, as result of which our aeronautical engineers used their ingenuity to reduce the external drag, caused by the struts and braces in the old wartime biplane, to produce the present monoplane used for both military and commercial types. To further achieve their aim the horsepower of aviation engines was increased by leaps and bounds. The horsepower output of internal combustion engines is proportional to the air pressure at the intake. Therefore, unless a pump of some type is used to increase this air pressure, the power of the engine will be reduced as the altitude is increased. Engineers in the solution of the problem of maintaining sea level horsepower at higher altitudes have designed superchargers (intake air pumps) to place sea level atmospheric pressure on the intake manifolds of the engines at all altitudes; thus materially increasing the power output of aviation engines in the lighter

air at high altitudes, resulting in a corresponding increase in speed due to this increased power and the decreased drag of the thin air at these altitudes.

In the search for more power with reduced weight of the engine per pound of horsepower, the octane rating of the fuel was materially increased from about 60 to the present rating of 100 octane. This has been responsible for about a 20% increase in horsepower of engines of the same weight over that obtained from use of fuel of lower octane rating.

This resumé of the past has been presented as a background of experience gained from the effects of improved weapons on military tactics and to show the rapid development in the airplane until it now becomes one of the deciding factors for nations at war.

Until preparations began for the present war in Europe, the armament on military airplanes consisted largely of .30 caliber machine guns, normally not in excess of four per airplane. Now pursuit airplanes, our smallest combat airplane, carry as many as 8 machine guns, one or more of which are .50 caliber, or as large as 20 to 37 m. m. rapid firing cannon. Armor for the modern airplane is also receiving consideration as result of experience in the present World War. This takes the form of armor protection for the pilot and gunners and specially designed leak proof tanks of fuel. There have been instances in the present war when airplanes have returned safely to bases with as many as 50 bullet holes in their structure.

In the air forces of all leading nations today will be found similar types of military airplanes, namely:

Training planes for the preliminary instruction of flight personnel;

Transport planes for the movement of freight and personnel;

Reconnaissance airplanes, small type, for Corps and Division observation over limited areas ;large type used for long distance strategical reconnaissance. The bombardment type of airplane is used for the latter mission.

Strictly combat aviation consists of bombardment and pursuit airplanes.

"Combat aviation is organized, equipped and trained in offensive and defensive air operations." "The power of combat aviation is measured not in the number of airplanes alone, but in terms of offensive fire power. This fire power is the result of range, volume of fire, accuracy of fire, destructive effect and airplane performance."

The most important of these types is the bomber; other types are utilized to assist the bombardment airplane in the performance of its missions. The bombers are classified as heavy, medium and light; pursuit, as interceptors or fighters.

The first recognized effect of the power of the modern airplane was the influence which preponderance of this weapon in the hands of Germany had upon the conference at Munich between England, France and Germany. The concessions which England and France were forced to make in this conference can be attributed largely to the knowledge that Germany was far superior in the air to the English and French air forces.

For the past five years, by individual sacrifice and utilization of her entire national resources, Germany had been preparing a war machine which would be ample to carry out by conquest the creating of a greater Germany along the lines mapped out in Adolph Hitler's *Mein Kampf*. This extended to the development of highly trained mechanized forces, with special attention being given to the production of the latest type of combat planes for her air force. The exact numbers are not known, but from the best information available it can be safely stated that at the time Germany invaded Poland she had approximately 10,000 combat airplanes and approximately 16,000 pilots in her air force.

Germany followed a very definite plan of attack when she invaded Poland, September 1, 1939. Having very accurate information as to the exact location of the Polish airdromes, the first mission assigned her air force was the destruction of these airports, all airplanes thereon and installations necessary for their operation and protection. As all her tremendous air force was not needed for this mission, it was used concurrently to destroy lines of communication in the rear of the Polish armies, which included highway and railway bridges, wire and radio communications, rolling stock on the railroad, marching columns of reinforcements and organized reserves for the Polish front line troops. This attack was so sudden, so devastating and so continuous as to cause utter confusion and rout to what was considered to be the well organized armies of a nation with a splendid reputation for high individual fighting qualities.

The devastation that could be wrought by the combined use of the ground and air forces was fully demonstrated by the rapidity with which Germany annihilated the Polish armed forces. Prior to the invasion of Poland by Germany, Poland was estimated to have approximately 1,000 airplanes, about one-third of which were of the combat type.

It may be of interest to you to know that the air tactics employed by Germany in the invasion of Poland were identical to those taught in our own Air Corps Tactical School for the employment of our own air force. May we hope that if this country is put to the crucial test, our air force may render equally valuable assistance to the success of our armed forces by the employment of these same tactics.

Due to Germany's complete preparation for war on a gigantic scale, events which were to shock the entire civilized world followed each other in rapid succession. On April 9th Germany moved through Denmark, and with her small navy, supported by her tremendous air force, achieved the impossible in face of the strongest fleet in the world, the English navy, by transporting some 30,000 of her armed force across the Baltic Sea to Norway, subjugating that ill-defended country in the space of 25 days. It is true that Germany paid a heavy price in carrying out this maneuver, in the loss of approximately one-fourth of her existing naval force and several thousand men on board transports. These losses were charged largely to the successes of English submarine and torpedo boat attacks, augmented by bombardment attacks made by English bomber formations. Due to the presence of the powerful German air fleets, the mighty English navy did not dare to accept the hazards of the punishment that could be inflicted upon it by German aerial bombardment.

From this statement it must not be deduced that an answer has been given to the much discussed question as to which is superior in an actual engagement, the airplane or battleship, but the British were fully confident of the fact that in the presence of large fleets of bombers a heavy toll would be taken of their capital ships, especially those of lighter construction. It has been claimed by the Germans, but not confirmed by the British, that the battleships *Rodney* and *Nelson*, two of the most modern battleships of the English fleet, had been successfully attacked and destroyed by aerial bombs.

Germany used her aerial transports and a great many of her bombardment type airplanes to assist in the rapid movement of her armed forces to strategic positions in Norway. By careful planning and quick action, Germany now had under her control all important airports of Norway, from which she could launch attacks against England over much shorter routes than those from airports on her own soil.

On the morning of May 10th Germany started through Holland. The employment of her air force was quite similar to that used in the invasion of Poland; that is, destruction of airports, the damaging of airplanes thereon, the bombing of

lines of communication and resistant points on or in the rear of the enemy front line, extending to the English channel of both Holland and Belgium. To her former tactics she employed an innovation by the use of parachute troops, which were dropped by the hundreds, nay even thousands, from bombers and transports at predetermined points in Holland and Belgium, where they quickly carried out their missions for which they had been so carefully trained that of quickly gaining control of all wire and radio communications, airports and vital points on highways and railroads; thus paralyzing the communications systems of the Allied field armies, so vital to any military operations. These parachute troops were equipped with light machine guns, radio sets and with very definite instructions as to assembly and missions to be performed. The German Stukas, or dive bombers, were sent over in wave after wave to make a concentrated bombing attack upon all points of resistance from the front lines, extending entirely across the terrain of these two small nations. Heavy tanks followed up the confusion and destruction brought about by the aerial bombardment. As soon as the heavy tanks had broken through the main line resistance, they were followed by motorcycles, armed with light machine guns and radios, in the rear of these were large concentrations of medium and light tanks, followed by infantry in trucks and artillery. As soon as these troops were in rear of the enemy front lines they fanned out so as to quickly cover large areas in the enemy territory. By severing lines of communications available to the allies, seizing bridges and other sensitive points in these lines of communication which Germany desired to use, and by quickly overcoming the formation of reserves by which a counter-attack could be made by the allied forces, confusion reigned supreme.

Allied commanders were cut off from contact with each other, and with limited means available for determining the disposition of their own forces, organized resistance became next to impossible. In this confusion large bodies of German troops were rushed through the gaps that had been made in the allied lines and consolidated the gains that had been made by her rapid moving, splendidly coordinated mechanized forces. Progress was extremely rapid, being as great as 30 or 40 miles per day. With the aid of bombardment formations, operating well ahead of the ground forces, it became difficult if not impossible for the allied armies to conduct any semblance of an orderly retreat. General Weygand, now placed in supreme command of the French armed forces, attempted to create a more flexible organization in depth, that his armies might have some opportunity of bringing these powerful thrusts of the

German mechanized forces to a halt and destroy them before they could be supported by their great mass of infantry and artillery divisions which were following up. As the French armies had lost the greater portion of their highly vaunted tank organizations, together with tremendous quantities of artillery and unprecedented man power (due to prisoners which were taken) the resistance of the French armies, which had the reputation of being the finest army in the world, was weakened and they were quickly subjugated. With her power to resist completely broken, France capitulated to the German armed forces on June 21st, just 42 days after the frontiers of Holland had been crossed.

Compare this with the four years of unsuccessful effort to defeat the allies made by the German armies in 1914-1918, when the man power of the German armed force was estimated to be at least twice as great in numbers as those in the present German army, and you will have some comprehension of the advantages which accrue to the nation that has provided itself with a highly mechanized army, the operations of which follow the well conceived and carefully laid plans of a superior staff organization. To this must be added the organization of these armed forces under a supreme commander who can dictate the well planned cooperation of all land, sea and air forces of the nation.

While the tactical dispositions of military forces must be organized to conform to modern weapons, the principles of war have not changed. These principles are nine in number and are as follows: The principles of the objective, of the offensive, of mass, of economy of force, of movement, of surprise, of security, of simplicity and of cooperation. Even the tactics being employed by our most modern weapon, the airplane, conform to these principles in the assignment to and carrying out of their missions. There was strict adherence to these principles of war just enumerated in the tactical dispositions and operations of the German air force in her successful conquest of continental Europe.

The people of the United States have always felt a pleasant security due to our geographical location, our tremendous manpower, our wealth of natural resources and our highly developed industrial organizations. We have originated and developed to a higher degree than any other nation, mass production. Knowledge of these advantages has created a dangerous indifference to the needs for well organized and trained armed forces for our protection against the aggression of foreign powers. The rapidity with which Germany has overcome all resistance in Europe has shocked our sensibilities to a rude

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awakening as to the ability of our existing national defense to perform its mission against a powerful aggressor. As our present interpretation of adherence to the Monroe Doctrine implies hemisphere defense, the deficiency of our armed forces has become of paramount interest to our nation. Public opinion is aroused to the point where the correction of the conditions of our national defense, that it may well perform its obligations in hemisphere defense, are to be provided. The present Congress has appropriated funds for creating a regular army of 400,000 men, and a large increase in the number of capital ships for the navy, making a total appropriation for national defense of approximately five billions of dollars. More funds may be forthcoming.

The air forces of both the army and navy are due for tremendous expansion. The President of the United States has declared himself for a 50,000 airplane program, of which approximately half this number will be in combat airplanes. Plans are at present being prepared to get this program under way as soon after July 1, 1940, as is possible. These plans, as they pertain to the Army Air Corps, will entail enormously increased capacity for the production of airplanes and other aeronautical and organizational equipment, with equally increased capacity for training of personnel. The procurement of material for all branches of the army has become a national effort, the supervision of which has been placed under a committee of outstanding industrialists specially selected by the President of the United States. An equally important task is that of providing trained combat and maintenance crews for these airplanes as they are delivered from the factories.

You no doubt will be interested in the plans that are being made to meet this enormously increased training program. Effective as of June 29th this year, a new class will begin primary training for 10 weeks, basic training for 10 weeks and advanced training for 5 weeks. "The size of these classes will increase progressively until the peak of 1300 is reached the middle of this coming October. The objective to be reached by July 1, 1941, is production at the rate of 7,000 military pilots per year. Concurrently there are to be trained in special schools, operated by the Air Corps, 3,600 bombardiers and navigators."

"This program just discussed pertains to the training of pilots. An extremely important phase of our training pertains to the highly developed enlisted specialist. Our program for 1939 included technical training for approximately 10,000 enlisted specialists. We are now making plans to expand these technical training facilities, including both military and civil,



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so as to train twice this number of specialists each year during the period of air corps expansion. This tremendous increase in our Air Corps will result in an increased number of tactical organizations in the General Headquarters Air Force. A plan is now being prepared and awaits the approval of the Secretary of War in which it is proposed to organize air force units into homogeneous wings, in so far as it is possible to do so and to form composite air divisions, each composed of two or more wings. The usefulness of a combat organization is based entirely upon its ability to accurately fly, shoot and bomb, hence the primary consideration in selecting sites for bases for these combat units is that local facilities may be available that the personnel of the air force may be adequately trained and become highly proficient in their flying, shooting and bombing."

It must be remembered that no bombardment mission can be successfully executed unless the combat team succeeds in getting through to the objective and placing the bomb load accurately on the target. It follows then that the most important member of each bombardment combat team is the bombardier. Those receiving instructions as bombadiers must be carefully selected and trained, that a maximum degree of success may be obtained from each mission assigned.

We have considered in a general way the development of the modern airplane, its utility as a military weapon, its importance and prominence in our present scheme of national defense, together with a general statement as to the organization of the Air Corps, that it may properly perform its mission. "The ultimate objective of the Air Corps is: to be prepared to conduct successfully such military operations as may be necessary to further whatever national policy may be adopted by our government in the present state of world affairs."

It is our hope that this aim may be quickly achieved, that it may provide a deterrent to all foreign nations who have designs upon increasing their prestige in the Western Hemisphere.

It is traditionally true of mankind that we have pity for the weak and respect, nay, even admiration, for the strong. We, the people of these United States, do not crave pity, but we do hope to gain wholesome respect from the nations of the world. When our present plans for augmenting our armed forces have been completed, the oft repeated words of our departed Ex-President, Theodore Roosevelt, will then have a real meaning—"Speak softly and carry a big stick; you will go far."

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FUNDAMENTALS OF ACOUSTICS SOUND WAVES AND THEIR SOURCES

By GERALD C. KERR *

Read before the Society June 10, 1940.

Tonight I have been able to secure from Johns-Manville Acoustical Headquarters the loan of a sound film that had been prepared by the Bell Telephone Laboratories under Dr. Harvey Fletcher. This film is something that should be a part of the education of every architect and engineer in college.

The film shows by means of high speed motion picture photographs how sound originates in violin strings, in drums and in other ways. It also shows by means of animated cartoons work how sound gets into the human ear and how it is interpreted by the brain. In addition it shows how sound is presented under different acoustical conditions and how echoes are caused and corrected in buildings. Finally it demonstrates the improvements that have been made in musical reproduction over a period of from thirty years ago to the present time. I wish especially to call your attention to the echo demonstration of the boy scout and his horn and also the oscillograph wave pattern of the violin and saxophone playing the same note.

(Note: Here the film was shown—Ed.)

The telephone companies in their ordinary transmission lines make little attempt to reproduce sounds below 200 cycles and above 4000. The intelligibility of telephone conversation is not very much affected by the frequencies below 200 cycles. But for broadcasting of the High Fidelity variety special wires are used that are more costly and which will reproduce a much larger part of the whole tone scale. There is a whole world of sound that we do not hear with our ears that is heard by the animals and birds. You have all seen robins after a rain cocking their heads to one side and then darting after a worm. The robin hears the moving of particles of sand against one another. Such sounds are so faint that our ears—wonderful though they are—can never hear them.

One of the early problems facing the acoustical engineer was to develop equipment to measure the loudness of sounds. Sound waves are transmitted by pressure variations in air, water, or building materials. These pressure variations are microscopically small. It is said that a million people would

* Acoustical Engineer, Taylor-Sidenbach Co., New Orleans, La.

Phone WALnut 0082

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have to talk for an hour before they would generate enough energy to furnish the heat required to boil the water for one cup of tea. The noise meter was one of the first instruments the sound engineer had to develop, and I wish to present the newest of these instruments, the General Radio Sound Level Meter. It has a range of from 24 to 130 decibels, which means from the hum of a mosquito to the explosion of a big gun on a battleship.

The decibel is the unit for measuring the loudness of sound. It roughly corresponds to the smallest difference in loudness that the ear can detect. The term comes from the telephone engineers and it is derived from Graham Bell. When the decibel scale is more widely known it will mean just as much to say the noise level in that office was 73 decibels as it does now to say the temperature yesterday afternoon was 100 degrees Fahrenheit.

Let us see the level of sound in our hall when everyone is quiet. You all hear a hum. That is due to the air conditioning system and the noise level is 56—58 decibels. Average conversation will range from 45—75 decibels. It will be noted that the sounds below 56 will be therefore pretty well masked by the noise from the ventilating equipment.

As engineers you will be interested in noise level sheets put out by Johns-Manville which embody the results of 10 years noise measurement work—largely done in New York City for the Noise Abatement Committee. A similar committee could help make New Orleans a much happier place by calling attention to the unnecessary noises to which we are all exposed. We hope that New Orleans will soon follow the lead of 40 or 50 other cities by outlawing horn blowing except to prevent an accident. It has been proved beyond dispute that noise harmfully affects the nervous and respiratory systems, blood pressure, digestive functions, and ordinary mental and physical efficiency.

Some common noise levels follow:—

Hayden Planetarium, New York—6 decibels (this noise comes from subway 2 blocks away).

Quiet country, 20—30 decibels. Fans and motors, 70—90; compressors, 80—100; cooling towers, 80; bedroom, 45; private office, 55; general office, 75; printing presses, 100; airplane propellers 10 feet away, 110; airplane test blocks, 130—140. These last can be heard 10 to 15 miles away to a disagreeable intensity and have caused trouble in a hospital in a Northern city before the stacks were sound proofed.

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There is a good deal of confusion in some circles on the difference between sound absorption, acoustical correction, noise reduction and sound isolation.

Acoustical correction usually means supplying enough sound absorbing materials to bring the period of reverberation to acceptable limits. This will vary from a broadcasting and a recording studio which should have period of $\frac{1}{2}$ second or less, to concert halls where there should be more reverberation and the period should be $1\frac{1}{2}$ to 2 seconds. The size of the hall is important as are the shape, furnishings and interior finish.

Noise reduction and sound absorption usually are employed to reduce unwanted noises in offices, hospitals, libraries and such like.

Sound isolation refers to those cases where you wish to prevent the passage of music or noise from one room to another. Engineers are frequently interested in keeping noisy machinery from bothering customers. The different types of problems require different treatment. At times a problem will require both acoustical correction and sound isolation — such as a broadcasting studio. One typical example of such a problem should be of interest.

It was planned to put some Diesel power generating equipment below an apartment which had wood joist floor construction. Preliminary surveys with the noise meter showed a level of 45 decibels in the bedroom above the location selected for the equipment. The Diesel registered 112 decibels. The difference was $112 - 45 = 67$ decibels. Further study showed that a reduction of 60 decibels could be secured using a concrete slab for the ceiling plus Johns-Manvilles #17 sound isolation construction. To give further protection walls of 4" hollow tile plus Johns-Manville #16 wall construction was used. In addition a good grade of sound absorbing (noise reduction) treatment was used for the walls and ceilings suitable for machine room use. This gave an additional 7 decibels of reduction. A floated floor similar to that used by the best broadcasting studios was employed to prevent vibration getting into the building proper. All structural ties were eliminated and special precautions taken to sound proof the ventilating system used to cool this equipment room. Special double door construction was used and the job worked out very satisfactorily. Broadcast studios usually aim at 60 decibels of a transmission loss between studios.

The same planning can be applied to other problems where economies can be effected due to centrally locating noisy equipment providing that it can be economically sound proofed and isolated.

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The sound isolating problems usually call for massive and weighty constructions, such as brick, hollow tile, concrete and the like, and good sound isolation takes care of doors and windows which are always weak spots. Sound isolating constructions vary in effectiveness according to their weight. Therefore, it will be easily seen that adding a soft light weight sound absorbing material to a structural wall will do very little to retard the passage of sound through such a wall. When additional weight is impractical good results are secured with the use of separate "floated constructions" which break the path for solid connections. The solid connections enable sound to travel with approximately 10 times the speed it can travel in air.

Many companies such as General Electric, Westinghouse, Frigidaire, American Blower and York have their own sound proof rooms where the noise of their equipment is recorded and tested. They are all trying to make their machines operate more quietly. The same is true of the auto and airplane manufacturers. We no longer feel that the noisiest equipment (or people) do the most work. The data secured by those companies is available only on special request and should be requested whenever trouble is anticipated. A special caution regarding churches, hospitals, bedrooms, and quiet offices is in order. Reference to our own noise level sheets will often indicate where trouble can be anticipated. If acoustical treatment has been used you should anticipate 5—10 decibels less noise. Sound isolating values of different constructions is available. A general formula has been found which indicates the amount of sound proofing needed for most air conditioning jobs—usually lining the ducts for 10 diameters will give good results in 95% of all jobs.

"Band Pass Analysers" have been used to measure the energy in several air conditioning systems. These analysers separate a complex sound into separate octave bands and measure the energy content in each band. They cost approximately \$1800.00 each. The most important information to date shows that all systems tested had most of their energy below 512 cycles. This is an important discovery, since it indicates that the economical solution to most noise troubles would require the use of a material with high absorption in the low frequency range.

Noise specifications are frequently used to avoid costly disputes and arguments. A common specification used for several years says that "the normal background noise level shall not be increased more than 3 decibels due to the operation of the heating, ventilating or air conditioning equipment." A speci-

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eration used recently by the U. S. Government reads "the noise level shall not exceed 40 decibels—using the "A" network of an approved noise meter." Both of these have their advantages.

In conclusion I am going to play for you four records selected to show the improvement in sound recordings that have been made over 30 years. The first is an old record of Caruso—the greatest tenor singer of all time. He is assisted by Galli Curci and De Luca and Perini.

You will note how thin, scratchy and tinny this record sounds of the Quartet from *Rigoletto*.

The second is a violin and piano record by Kreisler and Rachmaninoff. Kreisler has never appeared on the radio because he does not feel that it reproduces his music with sufficient fidelity. You'll note the improved quality of reproduction in this record. More base is heard.

The third is an orthophonic recording (method developed by Harvey Fletcher). Note more bass and treble. The record is of Heifetz playing "The Girl With the Flaxen Hair." Listen for the harmonics and overtones of his violin.

The last is about six months old and is by Alec Templeton showing how Dr. Walter Damrosch would do the "Three Little Fishes" on a music appreciation program. The quality here is very fine and quite life like. I hope you will enjoy it. Notice the absence of surface noise. It is a recent Columbia recording.

In review we have seen how sound originates in a vibrating object, how it is received in the ear, what steps have been taken to measure its loudness, and how its behavior in buildings can be controlled by means of both acoustical correction and sound isolation. We hope that from now on you will all be on speaking terms with the decibel.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

AUGUST, 1940

"PATRONIZE OUR ADVERTISERS"

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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.

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Regular Meeting of the Society in Baton Rouge May 10, 1940.

The meeting started with a delicious buffet supper in the Venetian Room of the University Cafeteria. One hundred fourteen members and guests were present.

President Pegues of the Baton Rouge Section made a few remarks of welcome, and outlined the evening's activities.

Dean Lassalle expressed regret that President Hebert could not be present for the occasion.

The meeting then adjourned to the Physics Building and movies of devices and methods of traffic research were shown.

Chairman Bedell of the Legislative Committee made a brief report on the progress and aims of his committee.

Chairman Stewart outlined the activities planned for June 20, the day of the annual outing, golf tournament and smoker.

The members then adjourned to view the exhibits in connection with the engineering student's field day.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Board, June 10, 1940.

The meeting was called to order by President Rhodes with the following present: Barnett, Kammer, Godat, Lassalle, Nelson, Ricker, Hill.

A letter was presented concerning the bill now pending in the Legislature and sponsored by some architects. Appropriate action was outlined in connection with this bill.

A letter was read from Walter Scales, asking concerning progress in connection with a consolidated index of engineering material in the libraries of the city. It was decided to keep Mr. Scales on as chairman of the committee considering this, even though Mr. Scales is absent from the city at considerable intervals. It was pointed out that there is now in progress the formation of a combined L. S. U.-Tulane Index.

Dean Lassalle outlined some of the major changes in connection with the proposed engineers' licensing law. In all cases the modification represented a compromise which did not materially weaken the bill.

There being no further business the meeting adjourned.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Society, June 10, 1940.

This meeting was held jointly with the American Society of Heating and Ventilating Engineers, New Orleans Section. President Rhodes called the meeting to order with 110 members and guests present.

The reading of the minutes of the May meeting was waived.

Mr. Klorer presented a resolution urging greater diversion of water at Chicago, into the Mississippi River. It was voted by those present that the resolution be forwarded to proper parties, with their endorsement.

Chairman Stewart of the Golf Committee told of the plans for the tournament and smoker on June 20, at the Metairie Golf Club.

Dr. Lassalle briefly outlined the progress made on the bill for licensing engineers, now in the Legislature. He urged that all who could, come to the meeting of the Judiciary Committee in Baton Rouge on Wednesday, at 3 p. m.

President Rhodes then turned the meeting over to Mr. C. B. Gamble, of the A. S. H. V. E. He introduced the speaker of the evening, Mr. Gerald C. Kerr.

The topic of the sound movies shown and explained by Mr. Kerr was "Fundamentals and Acoustics, Sound Waves and Their Sources." Mr. Kerr is acoustical engineer with Taylor Seidenbach Co., who represent Johns-Manville as approved contractors in New Orleans. A noise meter was also demonstrated.

There being no further business the meeting adjourned to the collation.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Board, June 15, 1940.

A special meeting of the Board was called by President Rhodes on June 15, 1940, noon. The following Board members were present: Barnett, Crump, Godat, Nelson, Ricker, Hill. By invitation Bedell, Billingsley, Dornblatt, McNiven, Negrotto were also present.

President Rhodes explained that the purpose of the meeting was to consider various phases of the passage of the bill for licensing professional engineers.

It was decided to send a letter to the membership of the Society, calling attention to the fact that the vast majority of professional engineers in the Louisiana Engineering Society and the local sections of national societies favored the passage of the bill.

It was further decided to send a letter to each member of Judiciary B Committee (House) outlining the true conditions in connection with the bill.

These two letters were drafted by the Board members. The Secretary was directed to send copies of the letter to each member of the Society, together with a brief outline of the main features of the bill.

There being no further business the meeting adjourned at 6 p. m.

A. M. HILL, Secretary-Treasurer.

LASEC NEWS

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Published Bi-Monthly

August, 1940

AS WE SEE IT

With this issue of LASEC NEWS, the Section embarks on its second venture in the publication of a bulletin that will prove a medium of expression and a purveyor of news for its membership.

In accordance with the recommendation of a committee appointed by President Lant, of which Mr. J. A. McNiven was Chairman, the Section voted to incorporate its publication with that of the Louisiana Engineering Society so that it might have a printed bulletin at the least cost to the membership and yet with widest distribution.

To accomplish this, LASEC NEWS is to be incorporated as a separate section of the Louisiana Engineering Society's "Proceedings." The members of the Section who are also members of the Louisiana Engineering Society

will receive the "Proceedings." Those members of the Section who are not members of the Louisiana Engineering Society will receive a reprint of the LASEC NEWS portion of "Proceedings." Thus the adoption of a new style and type for our publication marks a step forward. Since it will be published six times a year instead of monthly, your Staff has greater opportunity to gather material, resulting, we hope, in a more interesting publication.

It is the desire of your Staff to have the active rather than the passive cooperation of the Section. We solicit your contributions and criticisms. We EXPECT your support.

Thus realizing our shortcomings and our responsibilities, and with fervent zeal to gain your interest and approval, we launch this: Volume Two of LASEC NEWS.

NEWS ITEMS

Acting on the request of the National Defense Council to the Parent Society, the Louisiana Section has written the secretaries of the Associations and Chambers of Commerce in all major cities of the State, asking their cooperation in having all engineers, draftsmen and surveyors in their vicinity to come in and fill out cards furnished them by the Louisiana Section, giving their names and complete experience record. This procedure will enable the Parent Society to furnish the National Defense Council an exhaustive and complete record of the engineering personnel available for design and construction of airports, army and navy bases, and other works necessary for national defense, permitting procurement of trained personnel on comparatively short notice.

Plans are being made for a meeting of the Louisiana Section to be held in New Orleans in September, the feature of which will probably be an address by Admiral Leo Colbert, Director of the U. S. Coast and Geodetic Survey. When the date of the meeting is fixed, the usual postal card announcement will be made.

Engineers 30 to 45 years of age, physically qualified and experienced in the supervision of construction work, are being selected for service as Captain or Major, Quartermaster Corps, U. S. A. Engineers interested should send name, address, age and brief outline of construction engineering

experience to LASEC NEWS. Successful candidates will receive reply from Quartermaster General U. S. A.

The Fall Meeting of the Louisiana Section will be held in Baton Rouge some time in October. Tentative plans call for a visit to the new wharf now under construction at the Standard Oil Company's Refinery, with a discussion of its unique features by Mr. C. G. Cappel, Vice-President of W. Horace Williams Company, Inc., Engineers and Contractors.

At a meeting of the Board of Direction of the Louisiana Section on July 16, the Committee on Licensing of Engineers was named to confer with a committee of architects on their proposed A. I. A. Licensing Bill for the purpose of preventing conflict between the architects' and civil engineers' licensing laws.

On July 8 the Section was the guest of the Louisiana Post, Society of American Military Engineers and the Louisiana Engineering Society at the Jung Hotel in New Orleans to hear Brigadier General Frederick L. Martin's lecture on "The Airplane in Modern Warfare."

On July 10 the Section was joint host with the Louisiana Engineering Society and the Louisiana Post, Society of American Military Engineers at a Farewell Dinner to Lieutenant Colonel William F. Tompkins.

PERSONALS

We regretfully extend our farewell to Lt. Col. WILLIAM F. TOMPKINS who has left to take up a new assignment in Washington, D. C., as executive assistant to the Chief of the Civil Works Division of Office Chief of Engineers. GOOD LUCK, Colonel.

A hearty welcome from the Section is extended to Lt. Col. CLARK KITTRELL, new District Engineer, Second New Orleans District, who comes to us from Fort Peck Dam.

We are pleased to note that the Board of Administrators of the Tulane Educational Fund has elected BERNARD H. GREHAN to fill the vacancy on the Board left by the late Charles A. Favrot.

HOWARD KEENAN (Junior), a recent transfer from the Canal Zone, gave a piano recital at Werlein's on June 28.

MAJOR V. J. BEDELL is known ashore as our genial secretary, but it is not generally known that he is prominently connected with yachting activities in this section. The Major is a member of the race committee of the Southern Yacht Club and spends his week ends flagging winners on Lake Pontchartrain.

The many friends of PETE HAMILTON will be glad to know that he has been transferred back to New Orleans from Lake Charles.

HERBERT WILLIAMS has returned to his office after a period of illness. We are glad to see him looking so well.

ALLEN J. NEGROTTO will act as director for the Work Projects Administration in connection with the new secondary road program being sponsored by the Louisiana Highway Commission.

WALDO S. POWELL, Jr. (Junior) is attending a short course in soil mechanics at M. I. T.

The National Patriotic Council has selected COLONEL EDWARD S. BRES as one of its educational representatives. Colonel Bres recently attended a meeting of the Board of Direction at the Annual Convention in Denver.

GEORGE G. EARL and JOHN KLORER have been appointed to a steering committee of the New Orleans Association of Commerce to study the question of the diversion of water from Lake Michigan to the Mississippi River.

We say welcome to Col. MARCEL GARSAUD, who will soon be back as General Manager of the Board of Port Commissioners of New Orleans.

What about you North Louisiana and South Louisiana members of the Section sending in your activities to the Committee on Publicity at P. O. Box No. 1240, New Orleans.

EMPLOYMENT OPPORTUNITIES

Engineers, various grades, \$2600 to \$4600 a year. Branches—structural and welding. Closing date: August 5, 1940. (U. S. Civil Service announcement 83).

Senior Engineering Aide (Topographic), \$2600 a year. Closing date: August 15, 1940. (U. S. Civil Service announcement 79).

Engineering Draftsman (Ordinance), various grades, \$1620 to \$2600 a year. Closing date: June 30, 1941. (U. S. Civil Service announcement 73).

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RUPERT G. HODGES from Baton Rouge to Jefferson St., Port Allen, La.

CALVIN N. JOYNER from Gulfport, Miss., to Box No. 441, Ruston, La.

JOSEPH R. KINGSTON from Louisville, Ky., to Box No. 244, Franklin, La.

LEROY P. RAYNOR from Washington, D. C., to Room No. 314 Customhouse, New Orleans, La.

WALTER P. SIMPSON from New Orleans, La., to Box No. 6, Benjamin Franklin Station, Washington, D. C.

THE PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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JAMES M. ROBERT, Editor.

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Members may obtain key to rooms at hotel desk
All business communications should be addressed to Arthur M. Hill, Secretary, P. O. Station 20, New Orleans, La.

LOUISIANA ENGINEERING SOCIETY

STANDING COMMITTEES FOR 1940

STANDING COMMITTEES OF THE SOCIETY FOR 1940

[illegible]

The last name on each committee is the Junior member, who sits with the committee, but without vote.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. XXVI.

OCTOBER, 1940

No. 5

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EDITORIAL NOTES AND COMMENT

The Engineer's Responsibility in Civic Affairs. We rejoice in the honor and responsibility that has recently come to one of our members.

Mr. Arthur J. Naquin has recently been installed as president of the Young Men's Business Club. We offer to him our congratulations upon this honor and our sympathies in his heavy responsibility. We also congratulate the Young Men's Business Club upon having Mr. Naquin as its president.

Leaving personalities aside, Mr. Naquin's election is symbolic of two trends which affect very much the engineering profession. The first is an ever increasing recognition that the engineer is equipped both by temperament and by training

to assume a position of leadership in the non-technical and civic affairs of his community. This recognition of leadership takes many forms in numerous communities.

But much more important to the profession is the recognition by engineers themselves that, in the interest of rendering greater service, it is incumbent upon them to assume the obligation of this leadership. No longer can the truly responsible engineer leave community leadership to non-technical men while he buries himself in a mass of routine technical impedimenta.

The engineer is eminently fitted for community leadership. His is the duty to lead. His is the obligation to serve.

Personals. Last issue the LASEC NEWS was published for the first time as a part of these Proceedings. Attention is directed especially to the very interesting "Personals" column. This editor has frequently requested the members of the Louisiana Engineering Society to send similar items for inclusion in the Proceedings, but so far there have been no results. It is obviously impossible for the editor to know without being informed of all the events going on in the membership. Either from inertia or from a quite mistaken sense of modesty, members have refrained from sending in items about themselves. It is a mistake to assume that modesty requires silence. The other members of the Society are interested in your personal welfare and like to read such items. So send them in. And may we request you to see that the other members of the Society with whom you are in close personal contact do so too. Thanks.

Annual Meeting 1941. With the approach of fall, preparations for the Annual Meeting are getting under way. Our genial and efficient member, Karl P. Kammer, will serve as Chairman of the General Committee for 1941 Annual Meeting. This choice will meet with the hearty endorsement of all members, and in the meantime may be bespeak for Mr. Kammer cooperation of all members in giving him assistance and suggestions. We know that he will welcome all suggestions that will be helpful to the Committee.

BEN WILLARD

Ben Willard died in New Orleans on July 30, 1940. It is with deep regret that the Society recognizes the passing of one of its life members.

Mr. Willard was born in Utica, New York, on October 3, 1863, the son of Judge Joel Willard and Amy Ann Ladd. His early education was received in the grade schools of Utica, and his final training at Utica Academy.

In 1886 he became associated with the Thomson-Houston Company, and continued this association with its successor, the General Electric Company, until the time of his retirement in 1933. In this connection Mr. Willard was recognized as one of the pioneers in the electrical industry throughout the country, and his contributions to the industry while in New Orleans made this city one of the early leaders in this field of activity.

After spending several years in construction and engineering work in Boston, Chicago, and San Francisco, Mr. Willard was transferred to New Orleans in 1894, and following his arrival here, served as branch manager for the General Electric Company. His first major work in this city was to supervise the construction of 125 miles of overhead distribution system for electric railway service. This same design is still used as standard, not only in New Orleans, but in many sections of the country. He also supervised the initial electrification of drainage pumps and stations for the Sewerage and Water Board of New Orleans. Invention of the present traffic control light is attributed to his ideas and models, one of which was tested on Canal and Carondelet Streets ten years before the present permanent installation was made.

Mr. Willard was married on June 7, 1898, and is survived by his widow, the former Miss Mary Mansfield Copp, and one daughter.

His association with the Louisiana Engineering Society as a member dates from January 1, 1900, and active interest in the Society was maintained until the time of his death. In 1930 he was honored by being made a life member of the Society.

This testimonial is written as a mark of esteem from his fellow members and many friends. Therefore, be it resolved, that the record of a loyal member be spread upon the minutes and published in the Proceedings of the Society, and that the deep feeling of regret at his loss, be conveyed to Mrs. Willard through the medium of this resolution.

FRANK G. FROST,
HENRY J. MALOCHEE,
JOHN KLOSER.

Committee

WADE BARNETT

Wade Barnett, engineer in charge of design of pumping stations and mechanical equipment of the Sewerage and Water Board of New Orleans, a life member of the Louisiana Engineering Society and a director of the Society, was born November 18, 1876, and died in New Orleans after a brief illness on July 22, 1940. His widow, the former Miss Lutie Bennett, survives him.

He profited from a liberal education, classical and technical, as evidenced by degrees of bachelor and master of arts from the Jesuits' College of the Immaculate Conception in 1893 and 1894, respectively, and bachelor in the mechanical engineering course at Tulane University in 1897.

During the early years of his career he was associated with A. M. Lockett & Company of this city.

He entered the employ of the Sewerage and Water Board in 1905, at the time when the present sewerage, drainage, water and purification systems were organized. His work was to design the present buildings, concrete walls, reservoirs and passages of the present systems, as well as the special mechanical equipment necessary for successful and efficient operation. Much credit is due to Mr. Barnett for the attractive appearance of the Water plant and Pumping Stations throughout the City of New Orleans. His fellow-engineers honor him more for the detail design of the pumps and mechanical equipment.

From 1917 to 1920 he was granted a leave of absence from the Sewerage and Water Board so that he could work on a design of the pumping stations and equipment for the Sanitary District of the City of Chicago, including Evanston, Desplains and Calumet Pumping Stations. He resumed his work with the Sewerage and Water Board completing the design of the present enlarged drainage system.

In 1938 he was consulted by the U. S. Government in the design of very large syphons for the St. Francis River Project, Arkansas Drainage District No. 7. It was a matter of great pride to him to know that his predictions in the performance of these syphons was very closely met in actual performance.

At the Annual Meeting of the Louisiana Engineering Society in 1939 he was installed as a member of the Board of Directors; and, in recognition of his thirty years of membership dating back to 1910, he was made a life member at the Annual Meeting in 1940.

His knowledge, cultural and technical, his experience, his ideals of fairness and justice, his high engineering standards, all added to a most pleasing personality, won for him unstinted respect, esteem and loyalty.

The Louisiana Engineering Society has lost one who was most interested in its activities, in all its technical and social phases, and who faithfully served as one of its Directors.

Therefore, be it resolved, that the record of this loyal member and Director be spread upon the minutes of this Society and be published in its Proceedings, and further, that the deep sympathy of his fellow members of the Louisiana Engineering Society be conveyed to Mrs. Barnett in this hour of sadness.

HORACE E. CRUMP, *Chairman*,
LOUIS FRANTZ,
JOHN RIESS,

Committee.

August 12, 1940.

Welcome New Members. We extend a cordial welcome to the following gentlemen who have recently been elected to membership in the Society. Both they and the Society will derive great benefit from their membership:

Allen, Hunter S. Non. Res. Member. Age 40. Two years with Southern R. R., locating and constructing railroads in mountains of Tennessee and Kentucky, 1917-19; 1919-1922, locating and constr. engr., highways and bridges, Livingston, Tangipahoa, Washington, St. Helena and St. Tammany Parishes; 1922-23, Resident Eng. with La. Hwy. Comm., St. Landry and Pointe Coupee Parishes; 1923 to present, Estimate Dept. La. Hwy. Comm., as Auditor; present title: Asst. Office Engineer, Route 2, Baton Rouge.

Allen, Raymond I. Non. Res. Member. Age 35. Since 1925 with La. Hwy. Comm., 1 year, Rodman and location and constr.; 5 years Instrument man; 7 years Res. Engr. on Const. and Location; 2 years office employee, Drafting and Est. Dept.

Bottolfs, Carl E. Non-Res. Member. Age 35. September, 1922-May, 1923, E. E. course, L. S. U.; June, 1923-August, 1923, Rodman, Silver Falls Timber Company, Silverton, Oregon; September, 1923-May 1924, Portland Rwy., Light & Power Co., Portland, Ore.; May, 1924-October, 1924, Southern Pac. R. R., San Francisco; November, 1924-November, 1925, La. Hwy. Comm., and E. G. Freiler, C. E. & J. M. Fourmy, C. E., Chief of Party; November, 1925-July, 1927, United Fruit Co., Tela, Honduras; August, 1928-June, 1932, La. Hwy. Comm.; January, 1934-June, 1935, U. S. Coast & Goedetic Surveys; June, 1935-present, La. Hwy. Comm. 600 S. Holly St., Hammond, La.

Cooper, Robert S. Age 37. Instrumentman on concrete, asphalt paving, city storm and sanitary drainage, inspr. on state concrete paving, instrumentman in charge of gravel road construction, asst. res. engr. on bridges and bridge location engr. for Hwy. Comm., for past 11 years. Also made road surveys for the state. 3 years in C. E. course at L. S. U.. Has worked for La. Hwy. Comm. for 13½ years. Bridge Dept., La. Hwy. Comm., Baton Rouge, La.

Daigle, D. J. Non-Res. Member. Age 34. Graduate School of Eng., L. S. U.; 1 year exper. in Geophysical Research work, 7 years exper. with La. Hwy. Comm. 2231 Pocahontas Street, Baton Rouge, La.

Dobbs, William A. Res. Member. Age 31. Grad. of U. S. Naval Academy, 1932; 3 years with Fairbanks Morse as Sales Engr., handling Diesel power plant design, constr. and oper.; 2½ years with Shell Oil Co. as service engr. on problems of lubrication and indus. applications of petroleum products. 1322 Jefferson Ave., New Orleans.

Dubus, Andre J. State Member. Age 36. 1923-1924, Constr. Dept., Gypsy Oil Co., Tulsa, Okla.; 1924-1925 Inst. man and Bridge Insp., La. Hwy. Comm.; 1926-1927, Field Engineer, Do-mill Constr. Co., Bastrop, La.; 1927-1928, Field Engr. La. Power & Light Co.; 1928-1939, Right of Way Engr. in charge of all location, Gulf States Utilities Co., Lake Charles; 1939 to present, Indust. Sales Engr., Lake Charles & Baton Rouge. 740 Iberville Street, Capital Heights, Baton Rouge, La.

Ellis, Lloyd A. State Member. Age 39. 1924-1927, C. E. School, L. S. U.; 1925-1927, Estimate Dept. La. Hwy. Comm.; 1928-1929, instrumentman, La. Hwy. Comm.; 1930, Instrumentman on asphalt constr., La. Hwy. Comm.; 1931-1940, Res. Engr. on asphalt constr., La. Hwy. Comm. R. D. 2, Baton Rouge, La.

Foster, R. B. Res. member. Age 27. Grad. Tulane, B. E. in Civil Eng. 1933. 1933-1935, Engr. Fed. Land Bank, N. O.; 1935-to date, U. S. Eng. Dept. 2nd N. O. Dist., Insp. of contract levee constr., instrumentman on second order surveys. Present, Office Engr., Dredge Planning Section. 7708 St. Charles Avenue, New Orleans, La.

Gue'li, Peter J. State Member. Age 35. Since 1926 with Gulf States Utilities Co. as follows: 5 years distribution engr.; 2 years general sales work; 7 years industrial sales engr., care Gulf States Utilities Co., Baton Rouge, La.

Haas, S. G. Frank. Res. Member. Age 56. Grad. Tulane Univ., 1905, Chem. Engineering; 1 season with Oakley Planting Co., Ovoca, La.; 1 season as Chemist, Mexican Sugar Ref. Co., Telacotalpam, Mexico; since 1907, Tech. Engr., Sewerage & Water Br. of N. O., in charge of mech., steam. & hyd. testing, etc. at pumping stations. Since 1931 in charge of water purification. 59 Neron Place, New Orleans.

Hardie, William, Jr. Res. Mem. Age 27. Grad. Ala. Poly. Inst. 1937, B. Mech. Eng., M. S. (Mech. Eng.) Tulane, 1939. 3 years as Eng. aide for U. S. D. A.; 1 year as sales Engr. with Trane Co. 1013 Broadway, New Orleans, La.

de Laoreal, Wm. D. Junior Mem. Age 26. Grad. L. S. U. 1934, M. E.; 3 years Sales Eng. (machinery); 2½ years Air Condit. Sales Engr., all wth Fairbanks Morse & Co. 6330 St. Charles, New Orleans, La.

Murphy, D. W. B. Res. Mem. Age 29. Grad. Tulane Univ. 1937, M. & E. Eng.; past 2½ years as Engineer with N. O. P. S. I., doing rate analysis work. 317 Baronne Street, New Orleans, La.

Nilson, Cullen M. State Mem. Age 30. 1929-1933, Field Engineering, La. Hwy. Comm.; 1933-1937, Engr., Auditing Dept.,

La. Hwy. Comm.; 1937-present, Engr. Dept., Standard Oil Co. of La., Coordination Div., draftsman. 3956 Main Drive, N. Highlands, Baton Rouge, La.

O'Brien, Joseph T. State Mem. Age 26. Grad. L. S. U., 1934, B. S. in Elect. Eng. Employed since July, 1934, by Standard Oil Co. of La. as Process Engr, at Baton Rouge Refinery. 1990 Locust Street, Baton Rouge, La.

Reilly, Michael H. Res. Mem. Age 32. 3 years Engr. Dept., I. C. R. R.; 1 year Inst. man., M. J. Flynn; 5 years Supt. of Constr., W. P. A. Has worked for Illinois Central R. R. as draftsman doing shop drawings for locomotives, cranes and machines. 4402½ Canal Street, New Orleans, La.

Wehrman, Alvin A. Res. Mem. Age 29. Grad. Missouri School of Mines, 1933, B. S. in Civil Eng. Before grad. employed by Mo. State Hwy Dept. for 2 years in Constr. Dept.; since October, 1933, with Second New Orleans Eng. District as Dredging Inspector. 1036 Jefferson Avenue, New Orleans, La.

Williams, Gerald C. State Member. Age 26. Grad. L. S. U. 1934, B. S. in Mech. Eng. October, 1934, to June, 1936, employed as drafting engineer with Freeport Sulphur Co. March, 1937, to January, 1938, Drafting Engineer with Solvay Process Co. of Baton Rouge. M. S. degree, L. S. U. 1938. Since 1938, inspector with Standard Oil Co. of La. 646 North Street, Baton Rouge, La.

Williams, R. W. State Member. Age 31. Grad. Pennsylvania State College, 1932, B. S. in Mech. Eng. and M. S. in Mech. Eng. in 1934. Since 1934 employed in the Process Engineering Division of Standard Oil Co. of La. 2936 Adams Street, Baton Rouge, La.

Transferred from Student Member to One-Year Honorary Junior Members:

Bittenbring, Charles, Jr. Grad. Tulane University, 1940, B. E. in Civil Eng.

Samuelson, Hyman. Grad. Louisiana State University, 1940, in Civil Eng.

Re-Instatement:

Frederickson, John H., Jr. 331 Bellaire Drive, New Orleans, La.

Fluorescent Lighting. One of our members, Mr. J. M. Guilory of the New Orleans Public Service, discusses in this issue the latest development in fluorescent lighting. This development, while comparatively new, is gaining widespread acceptance as a means of modern lighting. His discussion is both instructive and up-to-date. It is interesting to note from his discussion that even fluorescent sources of light do deteriorate with use, just as do the tungsten lamps.

The Diesel Engine. A very interesting and informative article on both the history and the present status of the Diesel engine appears in this issue in a discussion under the above title by Mr. R. D. Campbell, Diesel Consultant of the Shell Petroleum Corporation.

He summarizes in very readable fashion the development which has taken place and which has led to the high performance of present day Diesel engines. Members interested in Diesel engines will derive much benefit from a reading of this article.

PAPERS AND DISCUSSIONS

THE DIESEL ENGINE

By R. D. CAMPBELL *

Read before the Society August 12, 1940.

Introduction

During the past decade the words "Diesel engine" have come from the lips of nearly every educated person, both in this country and abroad. Let us see why this word has excited the imagination of so vast a group of people.

When the old "horseless carriage" had reached a fair stage of development and had acquired the more dignified name of automobile, it was well on its way to popular acceptance. When the crude assembly of gadgets which constituted the early (and unreliable) thing known as "wireless" had reached a fair stage of development it took on the name radio, and became a **must** in every well furnished home. When the noisy old oil engine was improved and made a very useful part of our economic order, it took on the name Diesel engine—named after one of its most ardent advocates and a successful inventor—and soon was on the lips and minds of the general public. The name Diesel is to the oil engine what the name Edison is to electricity or Otto is to the gasoline type engine. Each of these great men took an idea and made it into a useful tool of our civilization, and we honor them by attaching their names to these fields in which they labored so successfully. Each of these men was an inventor, but more than that each of them improved on the ideas of others and produced an article which was useful in our economic system and having a real commercial value—not merely another theory or hypothesis.

The Diesel engine has been receiving this popular acclaim because it has reached a stage of development and usefulness such as to render a service to millions of people in their daily living routine. It is constantly invading new fields of service

* Diesel Consultant, Shell Petroleum Corporation.

where previously it was not applicable. The vast improvement in train service since the advent of the Diesel-powered trains has been featured by the railroads and popularized by the newspapers. This wave of popular acceptance is mentioned, not because the Diesel engine is a recent invention but to recall that fact that an invention may be relegated to years of obscurity until it undergoes the necessary development, improvement, and modification to make it a useful part of our daily lives before it received the popular acclaim accorded to such an invention.

Developments Leading Up to the Diesel Engine

The Diesel engine, as such, is over forty years old. It is difficult to state its exact age, for there is no set rule defining the time of birth of an invention. By custom we measure the age of a human being from the time it draws its first breath as an independent separate being. But there is no such well established rule for defining or dating the time of scientific achievement and invention. Here are some of the dates indicating important milestones in the development of what we now know as the Diesel engine:

1684—Huyghens' gun powder engine.

1804—Sadi Carnot wrote his well-known but purely theoretical Carnot cycle.

1856—Beau de Rochas wrote his cycle for an internal combustion engine.

1866—Otto and Langen constructed a free-piston engine on the de Rochas cycle.

1870—The Otto silent engine on the de Rochas cycle.

1870-1895—A period of intense development and experimentation on both gas and oil burning engines by such men as Otto, Langen, Akroyd, Stuart, Weiss, Hornsby, and others.

1878—Rudolph Diesel, a young Bavarian engineer and still a student, began toying with the idea of building an engine to operate on Carnot's ideal cycle.

1892—Diesel's paper on "A Rational Heat Engine," on which he is granted patents. It proposed an uncooled cylinder and powdered coal as the fuel!

1895—Diesel's first engine destroyed while attempting to start it with gun powder.

1896—Diesel's idea taken over by M. A. N. and Krupp of Germany where additional technical talent was available for developing and improving the idea into a workable machine.

1897-1898—The first Diesel engine built—but it had a cooling system and used petroleum as a fuel. Patents covered gaseous, liquids and solid fuels.

1898—The first American-made Diesel, built by the Busch interests of St. Louis as licensees.

What Is a Diesel Engine?

For the purpose of this discussion, it may be advisable to give a simple, non-technical definition of a Diesel engine as follows:

A Diesel engine is an internal combustion engine, generally using a petroleum fuel, operating at a sufficiently high compression ratio to produce temperatures of the air charge which will ignite the fuel when properly injected into the air charge in the combustion space. This is not a fool-proof, all-inclusive definition but is sufficient for our needs.

The action of the Diesel engine may be described briefly as follows:

The piston draws a full charge (unthrottled) of air into the cylinder on the suction stroke, the inlet valve closes, and the air charge is compressed to a pressure of approximately 500 pounds per square inch, which produces an air temperature of approximately 1000°F. (Fuel oil of good ignition characteristics—high cetane number—will ignite in the presence of air at temperatures of 800 to 850°F.) As the piston reaches the upper dead center position and the air is compressed to the conditions mentioned above, the fuel injection system projects a number of small sprays of atomized fuel into the region

occupied by the dense hot air. As the fuel penetrates the air it resembles a mist of perfume leaving an ordinary toilet atomizer. As it progresses into the dense air and the droplets become hot from contact with the air, each droplet bursts into flame simulating a tiny meteor; and the wake of each spray resembles the tail of a comet. Note that ignition does not occur at any one fixed point, as is the case of the Otto cycle engine, but that the flame is initiated or started at a myriad of points. Also, each droplet that bursts into flame releases heat which further raises the temperature and pressure of the air within the combustion space, thus assuring combustion of any particles of the fuel which are slow to ignite.

More time is required for the complete combustion of the fuel droplets than is required for the combustion of a perfect air-gas mixture as used in an Otto type engine. As a result of this longer period of combustion, the pressure rise within the cylinder is slower, resulting in the combustion process continuing during a portion of the expansion stroke. The slower combustion process is partly responsible for the fact that Diesel engines are not built to operate at as high rotative speeds as engines built on the Otto cycle.

As the combustion process occurs during a portion of the expansion stroke, the actual expansion ratio of the burned gases is not equal to the compression ratio, as is the case in the Otto engines, but is of the order of 7 or 8 to 1. This expansion ratio, however, is greater than the expansion ratio of an Otto engine, which normally has a much lower compression ratio, and herein lies one of the chief reasons for the high efficiency of the Diesel engine.

Also, there is no throttling of the inlet air into the Diesel engine cylinder. The free flow of the air into the cylinder reduces one of the minor losses, commonly referred to as pumping losses, which is ever present in Otto engines when operated at less than full throttle, i. e., partial loads. It may be advisable to compare some of the facts, figures, and conditions of the Diesel engine with those of the Otto engine with which we are more familiar.

Item	Otto	Diesel
Compression Ratio.....	6:1	15:1
Expansion Ratio.....	5:1	7:1
Compression Pressure.....	120#	500#
Inlet Air Temperature.....	150°F.	70°F.
Compression Temperature	400°F-600	1000°F.
Firing Pressure.....	500#	750#
Firing Temperature.....	3000°F.	3000°F.
Good B. M. E. P.....	100-110#	
	Sq. In.....	80-90# Sq. In.
Fuel and Air mixed in.....	Carburetor and Mani- fold	Combustion Space
Ignition.....	Spark	Compression Tempera- ture
Points of Ignition.....	1 or 2	Many
Fuel at Time of Com- bustion	Gas or Vapor	Liquid
Control.....	Quantity of mixture	Quality of Mixture
Weight per H. P.....	100%	150%

History of Diesel Engine Development

After the production of the first Diesel engine, there remained many obstacles to overcome, chief among which was its need of improvement and its lack of public acceptance because it was a radically new and untried machine. During its early years when it was protected by patents and its manufacture was limited, the "hot bulb" or low compression oil engine continued to gain in popularity. The growing use of the low-compression oil engine, however, paved the way for the public acceptance of the Diesel, and when the patents expired several engine manufacturers entered the Diesel engine field. The decade 1900 to 1910 saw the Diesel engine being improved and applied in limited fields, particularly submarines, municipal power plants, and in certain isolated plants where other forms of power were not available.

The decade 1910-1920 saw the Diesel engine being improved and modified in many ways, chiefly because the original patents had expired and many manufacturers had entered the field. As a general rule, each new manufacturer was responsible for introducing one or more important ideas which were embodied in his particular engine. Mechanical injection systems were generally tried out with the idea in mind of replacing the more complicated and expensive air injection systems on the medium and small size cylinders. Multi-cylinder engines in sizes up to 1,000 H. P. and larger were built. The general acceptance of the Diesel became more pronounced and it was tried abroad in locomotives and rail cars. Oil pipe lines, drainage and irrigation plants, mines and marine applications were popular fields for the Diesel.

Each new decade has seen the Diesel improved and adopted more rapidly than in the previous ten-year period. During the period 1920-1930, the manufacture of Diesel engines was begun by thirty-one companies, while very few of the earlier manufacturers discontinued the making of Diesel engines. Mechanical injection systems were generally adopted to replace the air injection systems for all but the largest size cylinders burning the lowest grade fuels. Engines as large as 4,000 H. P. were built, and sales reached the 500,000 H. P. mark in 1928. Engines of both the 2-stroke cycle and 4-stroke cycle were popular. Many municipalities built their own electric system and took advantage of the economy of the Diesel to produce the power. Small steam engine plants which were obsolete or inefficient were replaced with Diesel engine power. The smaller and more compact Diesels resulted in many marine installations in tugs, tow-boats, fishing vessels, and other small craft. Cotton gins and ice plants were popular southwestern industries where the Diesel found favor. Prior to the advent of the widespread network of power lines, many cotton gins in isolated places had to choose between the steam engine and the oil engine as a source of power. While ice plants were usually located in places where electric power was available, the length of their operating season and the relatively high load factor indicated the selection of the Diesel engines for

the source of their power. The availability of fuel oil and the lack of adequate electric power in many communities resulted in the Diesel engine being a "natural" in such states as Arkansas, Louisiana, Texas, Oklahoma, and Mississippi.

The decade of 1930 to 1940 witnessed so many events occurring in Diesel history and this period is still so fresh in your memories that it will not be outlined as completely as its accomplishments merit. Tractors, trucks, buses, airplanes, trains, shovels and draglines all saw the Diesel tried and in many cases adopted as their most suitable source of power. Diesels, particularly in the new streamlined trains, were front page news. The number of Diesel engines being purchased for each of the above mentioned services was increasing yearly, which would imply that the adoption of the Diesel into these fields had passed the experimental stage.

Besides receiving wide adoption in the mobile and portable fields of service, recent years have witnessed a growing popularity of the medium size Diesel in small industrial plants. The large, slow speed Diesel had a high initial cost, required a large foundation and from 14 to 20 feet of head room, and was not well suited to the needs of small power users. Also, the vibration produced by an engine of two or three large cylinders, each developing a large amount of power at every stroke, was objectionable in many cases. In contrast, the small, high speed unit was noisy and not so generously rated as the larger engine. A very acceptable in-between unit has appeared on the market in recent years. It consists of a multi-cylinder unit of 25 to 50 horsepower per cylinder, operating at speeds of 450 to 750 RPM, having good fuel economy and requiring less than eight feet of head room in which to pull pistons. This medium size, medium speed Diesel engine is in every detail a small model of the large heavy duty type of Diesel engine. The development of this medium size Diesel clearly demonstrates the alertness on the part of the engine manufacturers to develop and offer engines for definite markets. In many cases, this medium size Diesel has been adopted for draglines, small vessels and other services where its size and speed makes it well suited to the purpose.

Types of Diesels

A Diesel engine designer or a manufacturer considers a Diesel engine from the standpoint of such classifications as:

Two-stroke cycle or four-stroke cycle

Solid injection or air injection

Individual fuel pumps or a common rail

Crankcase, blower, or pump scavenging

Shape of combustion chamber

Rotative and piston speeds

Service modification or type.

Of the above groupings or classifications, the last two are, as a rule, of greatest interest to the Diesel engine user. In recent years, the rotative speeds have been generally classified as follows:

Speed Class	R.P.M.	Probable Piston Speed in Feet Per Minute
(1) Slow speed	Up to 500	800-1100
(2) Medium speed	500-1000	900-1500
(3) High speed	1000-1500	1200-1600
(4) Automotive	Over 1500	1400-2000

H. S.

From the user's standpoint, the RPM is more important than the piston speed. The piston speed is a matter for the designer to study, as it has a bearing on the life of the moving parts in the engine and lubricating problems. In many cases it is well to subdivide the slow speed classification into two groups with 300 R. P. M. being the dividing line. There is a difference in size and type of engines which makes this subdivision useful in selecting engines for certain services.

The second important classification of Diesel engines, as far as the user is concerned, is the application or service modification. This classification refers to certain changes or modifications which make the engine particularly well suited to a certain type of service. These modifications are, as a rule, readily recognizable to one who is familiar with Diesel engines, al-

though to the uninitiated an engine is an engine. The more important application or service modifications are:

- | | |
|----------------------------------|------|
| (1) Stationary | (S) |
| (2) Marine—Direct reversing..... | (Mr) |
| " —Reverse gears | (Mg) |
| (3) Tractor | (T) |
| (4) Automotive | (A) |
| (5) Mobile or Portable..... | (P) |
- (1) Almost unlimited in weight and size; separate auxiliaries; box-base may be used; bedded crankshaft; heavy flywheels, especially for electric generating service; levelled on heavy foundation. (2) Moderately compact; some built-in auxiliaries; marine or V-base always used; water-cooled exhaust manifolds; bedded crankshaft; large sizes directly reversible, small sizes have reverse gears; thrust bearings inside of crankcase; arranged for variable speed control; engine frame is deep and very rigid; small flywheel. (3) Reasonably compact; auxiliaries built-in or attached; engine has suspended crankshaft; exhaust manifold uncooled; gasoline engine or electric starting used; weight may exceed that of the automotive type engine; standard SAE flywheel housing for clutch. (4) Quite similar to your automobile engine, but it has a fuel pump and no spark plugs. (5) Quite similar to type (2) except engine is not direct reversing. This type is used for draglines, dredges, locomotives, and similar portable or mobile applications. Must have a thrust bearing due to operating in various positions. Marine type base and cooled manifolds preferred.

Each of the above types of engines is available in two or more speed ranges. There is an American made Diesel engine for almost every conceivable power requirement up to 10,000 horsepower per engine. Airplane Diesel engines are again in production, but the horsepower sizes are not available except between 150 and 310 horsepower.

As engineers, you are aware of the advantages of selecting a machine designed for a specific application rather than substituting another type of engine and ending up with a "make-shift" piece of equipment. The wide range of speeds and types offered today permits the selection of a proven de-

sign for almost any application. These remarks regarding the proper application of Diesel engines are made because it is the author's experience that much of the dissatisfaction encountered in connection with the use of Diesel engines is due to rank misapplication. We do not expect a direct-current electric motor to operate on alternating current, nor a 440-volt motor to operate on 220 volts, nor a centrifugal pump designed for 100-foot head to deliver water against a head of 200 feet. It is just as inconsistent to expect satisfactory performance from a misapplied Diesel engine!

Economy of the Diesel Engine

Foremost among the many reasons for the existence and use of the Diesel engine is its economy. The initial cost of a Diesel engine of moderate size is somewhat higher than the cost of a gas engine of equal capacity, but somewhat lower than the combined cost of a boiler and steam engine erected and ready for service. However, the initial cost is only one phase of any power cost problem, for the operating expenses (fuel, labor, lubricants, maintenance, etc.) may far outweigh the item of initial cost. A Diesel engine under average conditions will use from 60 to 80 per cent as many gallons of a fuel which costs approximately 70 to 80 per cent as much as commercial gasoline ex taxes. No attempt is made to quote the prices of fuel oil, gasoline, or other fuels with which the Diesel engine is competing. Prices of fuels vary from month to month and from territory to territory. On an average, a Diesel may be said to save 40 per cent on the fuel bill compared to gasoline engines and XX per cent when compared to engines using other fuels. The question for the engineer to settle is "How much can be saved in total power costs?", or "Which is the cheapest form of power for my particular needs in my particular area?"

Any attempt to quote figures, costs or savings on a power problem without having all of the data, facts, and conditions at hand would certainly constitute a breach of sound engineering. For this reason your attention is called to the fact that all figures quoted herein are to be considered as general aver-

ages or approximate figures and should not be applied to specific problems.

Reliability of the Diesel

The trend for many years has been to incorporate reliability and replaceability into every Diesel engine design. A Diesel engine is far more reliable and has a greater life than an average automobile engine. This is one reason for the greater cost of Diesels than gasoline engines. One hundred thousand miles may be considered a fair life for an automobile engine. This is equivalent of only 2,500 hours of operation at 40 miles per hour—and an automobile engine is required to produce only 25 to 50 per cent of its available power during most of its running time. Diesels really make their best economy records when operated at 60 to 90 per cent of their rated power. However, even the smallest Diesels have an anticipated life several times as long as an equal size automotive type gasoline engine. Large Diesels are expected to run from 4,000 to 10,000 hours between major inspections or clean-up periods. These figures are indicative of the relatively long life of the Diesel engine and its reliability.

The majority of Diesel engines have replaceable pistons, cylinders or liners, bearings and other moving parts. When the engine becomes badly worn the owner replaces these parts rather than discarding the entire engine. These are only a few of the many reasons contributing to the relatively long life of Diesel engines.

There is probably no better example of fine machine work, finished to tolerances of less than .0001 inches on a production basis than is indicated by the manufacturer of fuel injection equipment for modern, high speed Diesel engines. The interchangeability of bearings by the use of bearing inserts is another feature adopted and improved by the Diesel engine manufacturer. While the Diesel has borrowed many ideas from the automotive field, it has also contributed much to the automotive field in pointing the way to increased engine life and reliability.

Fuels and Lubricants for Diesel Engines

For many years the statement was made—and went unchallenged—that the Diesel would burn anything including crude oil, vegetable oil, animal oil, and a number of other miscellaneous substances. This statement is true to a large degree if reference is made to the large, slow speed Diesel engine. However, it was found that even the large engine gave better performance and overall economy when supplied with suitable fuel. Fuel containing grit, dirt, and water causes excessive wear to the fuel injection system. Fuel high in gasoline content—such as crude oil—does not burn smoothly and results in excessive wear to certain parts of the engine.

The development of the small high speed Diesel engine was accelerated by the production of suitable fuels for its needs. As a rule, these engines operate on distillate fuels taken from the refinery process between the kerosene and lubricating oil fractions. The important characteristics of a Diesel fuel oil are: cleanliness, ignition quality, viscosity, and distillation range. These are not all of the properties to be considered in connection with suitable Diesel engine fuel; however, they constitute the most important of the list. Gravity has little or no direct significance as to the suitability of a fuel for Diesel engines. The study of Diesel engine fuels is a complete subject on which many men are devoting their entire time. To attempt to discuss this subject in a brief period might create the erroneous impression that it is of relatively little importance. It must be pointed out, however, that the success and widespread use of the Diesel is as much dependent upon the availability of a satisfactory fuel oil as the success of the modern automobile is dependent upon the availability of suitable gasolines.

The Diesel engine has imposed certain conditions on lubricating oils which are more severe than those encountered in automobile engines. Such conditions as high load factors, high temperatures, dilution by fuel oil, and formation of soot and carbon within the engine when the fuel system is out of adjustment require that a Diesel engine lubricant be refined to suit the purpose. Large slow speed Diesel engines do not pre-

sent as serious a lubrication problem as do the small high speed units. The reason for the differences in the two speed classes of Diesels are tabulated as follows:

Condition	High Speed	Slow Speed
Crankcase Oil, gallon per rated H. P.....	.025 to .10	.10 to .50
Temperature of Oil in crankcase.....	175-225°F.	120-150°F.
No. Piston Rings per piston.....	4-5	6-7
Strokes per minute.....	1500	300

Besides the above differences, the large stationary engines are usually equipped with rather elaborate oil filters and operate within a clean building, which is in contrast to the smaller oil filters and dusty operating conditions frequently encountered by the automotive or portable Diesel engine.

As a general rule, the small Diesel engines are not equipped with pyrometers or other instruments which may be used to indicate the operating condition of the engines. Also, the operator of the small engine is, as a rule, a truck driver, tractor operator, or dragline operator whose primary duty is to operate the equipment of which the Diesel engine is only one part. In plants containing the large stationary Diesel engine, there is usually an engineer or operator whose chief responsibility is to observe and operate the engines.

The aforementioned conditions have indicated the need for a Diesel engine lubricant of extremely stable qualities and detergent properties which will assist in keeping the engine pistons, rings, and cylinders clean, free from carbon, and in good operating condition at all times. Oils of these qualities and properties have been developed by a number of the major oil refiners, and it is anticipated that the improved reliability of the Diesels due to the use of such oils will result in an even greater acceptance of Diesel engines in portable and mobile equipment.

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TECHNICAL ASPECTS AND APPLICATIONS OF FLUORESCENT LIGHTING

By J. M. GUILLORY *

This paper was presented by H. L. Salaun, of the New Orleans Public Service at a meeting of the Society September 9, 1940.

Fluorescent lighting is generally publicized and accepted as the newest light source, yet records indicate that Thomas A. Edison, in 1896, invented what was essentially a fluorescent lamp. However, it was not until 1938 that a commercially practical design was developed. The introduction of the lamp at the New York World's Fair initiated the wide public interest in this radically different and efficient light source.

In view of the totally different appearance, principle of design, and characteristics of operation, technical details relative to these factors may be of interest.

The Lamp Bulb or "Tube"

The fluorescent lamp is a form of electrical discharge source similar in principle to the commonly known "Neon" tubing. The lamp proper is essentially a glass tube with an electrode sealed in each end. There is no wire or filament connecting the two electrodes such as there is in the "lumiline" lamp. There is a small amount of argon gas to facilitate starting, and a small drop of mercury which vaporizes to sustain the arc which strikes when voltage is applied across the electrodes. The inside of the tube is coated with a powder which is white when unlighted. This powder fluoresces with a color dependent upon the composition of the powder. The lamp sizes presently available are 15 w, 20 w, 30 w, and 40 w. A 100-watt lamp will be available in October, 1940. The light output per watt of the white fluorescent lamp is approximately $2\frac{1}{2}$ times that of the filament lamps normally used for general lighting. (This ratio includes auxiliary wattage.)

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Principle of Light Production

The mercury vapor arc which fills the tube emits a small amount of visible radiation. However, approximately 66% of the total energy input to the lamp is invisible ultra-violet radiation at a wave length of 2,537 angstrom units.

It has been found that certain chemical powders become luminous when exposed to ultra-violet light of between 2,000 and 3,000 angstrom units, so that the **invisible** ultra-violet is transformed into **visible** light of a color depending on the particular powders (called phosphors) which are used.

Practically all of the visible light from the fluorescent lamp is a result of the ability of these powders to "act as transformers" from invisible to visible light.

In the fluorescent lamp 43.5% of the lamp energy is radiated as heat. By comparison, 60 to 75% of the total energy of a tungsten lamp is radiated. Thus, the effect of radiant heat is much less with fluorescent than with tungsten lamps. However, the total heating effect to be considered in refrigeration loads, such as display cases, coolers, etc., will be the basis of total wattage. In air conditioning installations the lesser heat radiation may permit some deviation from this, but as yet no definite values have been developed.

Auxiliary Equipment Required for Operation

Fluorescent lamps, in common with all electric discharge sources, require auxiliary control equipment. An iron core choke coil limits the current flow, or prevents the arc current from building up to an excessive value. A starting switch permits heating of the electrodes, and then opens the circuit quickly to "strike" the arc.

The cycle of operation is as follows: when the switch is closed, current flows through the ballast, through one electrode, then through the starter switch, then through the other electrode and back to line. The heated electrodes emit electrons, and when the bi-metallic strip in the starter opens the heater circuit, the arc strikes in the tube. The lamp then operates across the line in series with the ballast.

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The starter switch was one source of trouble in the original lamps. This trouble has been eliminated by the development of the glow type switch.

The switch is enclosed in a small glass bulb and consists of two electrodes, one of which is made from a bi-metallic strip. These are separated under normal conditions and form part of a series circuit through the lamp electrodes and the reactance. When voltage is applied, no current flows except as a result of the glow discharge between two electrodes of the switch. A heating results which, by the expansion of the bi-metallic element, causes the electrodes to touch. This short circuiting of the switch, which takes one or two seconds to be completed, allows a substantial flow of current to preheat the lamp electrodes. There is enough residual heat in the switch to keep it closed for a short period of time for the pre-heating. With the opening of the switch, the resultant high voltage surge starts normal lamp operation. If the lamp arc fails to strike, the cycle is repeated.

The switch does not again glow (if the lamp arc is established) since it is so designed that the remaining available electrical potential is insufficient to cause a breakdown between its electrodes. Thus it consumes no power and if the lamp is turned out, is available for immediate restarting.

There is a wattage loss in the auxiliary or ballast, the amount of which depends on the type of unit and size of lamp, but is of a magnitude ranging from 20 to 33% of lamp wattage. Single lamp ballasts have a power factor of 55 to 60%. This may be corrected, (either singly or in groups), or raised to a desirable level (95 to 100%) by the use of proper condensers. However, auxiliaries are now available which permit the operation of two lamps from one ballast unit. With this unit the power factor is from 95 to 100%.

The use of low power factor equipment is obviously undesirable, as line capacity is used up, heating losses are higher, and voltage is adversely affected.

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While it is possible to operate the fluorescent lamp on D. C. through the use of resistance, it will not give comparable service, as it is basically an A. C. lamp.

Operating Characteristics of Lamps

Unlike tungsten lamps, the life of fluorescent lamps does not increase when operated **under** rated voltage; nor does the efficiency increase when operated **over** voltage.

Depreciation in light output of fluorescent lamps after the first hundred hours use is approximately the same as for tungsten lamps. Rated lumen output is determined at 100 hours. The rate of depreciation is very similar to that of tungsten filament lamps.

Thus, it can be seen that foot candle readings taken on a new installation may be considerably higher than that designed for on the basis of rated lumen output.

Useful Lamp Life

In general, fluorescent lamps lose their usefulness because of decrease in light output before they fail to operate. Darkening of the bulb occurs because of the effect of mercury on the fluorescent coating and because of the material given off by the electrodes. The latter especially causes darkening at the ends of the bulb late in life. The rate of depreciation in light output diminishes throughout life; the first hundred hours produce about as much darkening as the following 1,000 hours. Rated output is based on conditions at 100 hours.

Frequent starting of lamps may take more life out of the electrodes than long hours of burning because momentarily there is a higher than normal voltage drop at the electrodes, which causes the active material to sputter or evaporate off. If a lamp is started once a minute, for example, the hours of burning will be shorter than normal. When the active material on the electrodes is nearly exhausted, the voltage required for starting will rise and may equal or exceed the available supply. This may occur after the lamp has been started thousands of times or burned beyond its rated life. Sometimes the end of life is indicated by the lamp flashing momentarily and then going out.

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Effect of Air Temperature

Fluorescent lamps operate at maximum efficiency when the bulb temperature is from 100° to 120° F. Low temperatures, however, cause greater reduction in light output than high temperatures. As might be expected, cold drafts greatly affect light output.

Stroboscopic Effect of Flicker

Every source of illumination that is burned on alternating current supply has a non-uniform light output as a result of the cyclic variation in current. With filament types of lamps, this effect, while in existence, is not noticeable to the eye except with very low current lamps at low frequencies. With usual sizes of filament lamps, say 60 watts and above, on standard alternating supply current, which in general is 60 cycle, no effect from cyclic flicker is noticeable to the eye. With fluorescent lamps, however, in which the main source is an arc, a cyclic or stroboscopic effect is somewhat more in evidence. Fortunately, the fluorescent materials used, with the possible exception of that producing blue light, have some phosphorescent as well as fluorescent powers. This phosphorescence produces a latent or delayed glow, so that even at the dark points caused by the alternating cycle some illumination is still in evidence. The magnitude of this flicker or its result on illumination is indicated by table following. It is fortunate that this variation in light output with each cycle can be largely eliminated by the use of available operating equipment. Such equipment, which permits lamps being operated in pairs, results in the high point of the light cycle from one lamp occurring at approximately the same time as the low point of the light cycle of the companion lamp, thereby producing practically uniform non-varying light throughout each complete cycle. Another method of eliminating noticeable flicker is by installing a minimum of three lamps located adjacent to one another and supplying each lamp from a separate phase of a three-phase circuit.

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Red	10
Daylight	55
Daylight (two lamps operated out of phase).....	25
White	35
White (two lamps operated out of phase).....	16
40-watt filament (on 60-cycle AC).....	16

Radio Interference

There are three possible sources of radio interference in the operation of fluorescent lamps. These are, (1) arc radiation, (2) line radiation, (3) feed back through the line. A shielded lead-in will eliminate the first trouble, which is objectionable only if the set is within 9 feet of the lamp. The second and third sources of disturbance may be eliminated by the use of line filters at the lamp.

Applications

Since colored light may be obtained at efficiencies up to 100 times that obtained from filtered filament light, a new economical means of "painting with light" is made possible for providing atmosphere, or in architectural applications.

A color quality closely approximating daylight is now available for installations where color discrimination is a factor. For interior lighting, the daylight lamp appears "cold," and the white lamp is usually preferred.

In coves, wall and show cases, silhouette signs, and some residential applications, the fluorescent lamp is an ideal illuminant.

In the field of general lighting, there is presented an opportunity for securing lighting levels which have been desired, but which heretofore have not been practicable. Caution should be exercised, however, in the design of an installation, to assure



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selection of equipment of the proper type, size, distribution characteristics, and brightness.

For industrial use, equipment has been designed for localized or general lighting which is admirably suited to the job.

For store lighting, there are available very many shapes and sizes of fixtures. Some have the lamp shielded with louvers or diffusing material. Others use exposed lamps, with possible objectionable surface brightness or glare, particularly if mounted directly in the line of vision.

The engineer or architect should be particularly cautious in the design of lighting for offices, libraries, drafting rooms, or schools where continued close visual tasks are performed. Care should be taken to avoid direct or reflected glare, harsh or sharp shadows, or spotty illumination.

Before concluding, mention should be made of the comparative cost of fluorescent lighting and of filament lighting. The total cost of any lighting system involves: cost of electrical energy, cost of lamp renewals, maintenance costs, and interest and depreciation costs on the investment in fixtures and equipment. In order to arrive at an exact comparison, it is necessary to evaluate each of these items as it applies to each specific installation, reducing the costs to a basis of equal amounts of light of a comparable quality.

Properly applied, fluorescent lighting offers a real opportunity to provide "indoor daylight" for conservation of eyesight; for increased sales to the merchant; and for increased production in industrial operations.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

OCTOBER, 1940

"PATRONIZE OUR ADVERTISERS"

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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.

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Society, July 8, 1940.

The meeting was called to order in the Mirror Room of the Jung Hotel with approximately three hundred members and guests present. The meeting was opened by President Rhodes.

The reading of the minutes was dispensed with. A few announcements were made and then the meeting was turned over to Lt. Col. W. F. Tompkins, President of the Society of American Military Engineers, as this was a joint meeting with them.

President Tompkins introduced the speaker of the evening, Brigadier General F. L. Martin, Commanding General of the Third Wing of the G. H. Q. Air Force.

General Martin's paper was entitled "The Airplane in Modern Warfare."

The meeting closed with a rising vote of thanks to the speaker. Members and guests then adjourned to the collation.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Society, August 12, 1940.

The meeting was called to order by President Rhodes with approximately 100 members and guests present.

The minutes of the last meeting were read and approved.

Mr. Frank G. Frost presented a resolution upon the death of our life member, Mr. Ben Willard. This resolution forms a part of these minutes.

Mr. Horace E. Crump presented a resolution upon the death of our life member and member of the Board, Mr. Wade Barnett. This resolution also forms a part of these minutes.

Mr. Ole K. Olsen, Chairman of the Entertainment Committee, rendered a very complete report on the testimonial dinner tendered Lt. Col. Tompkins in co-operation with other organizations. He also discussed the advisability of planning a picnic across the lake, to take place within the next few weeks. A vote of those present seemed to indicate that sufficient interest would be shown to make the event a success.

President Rhodes then introduced Mr. R. D. Campbell, who spoke on "Diesel Engines." Mr. Campbell is a Diesel consultant, and is an associate of the Executive Committee, Oil and Gas Power Division, A. S. M. E. He is connected with the Shell Petroleum Corporation.

The paper was extremely interesting, and was supplemented with blackboard charts, and mimeographed sheets.

Mr. Eugene K. Schultz of the New Orleans Public Service read a brief paper on their experiences with a Diesel-electric bus. Numerous facts and figures were quoted, giving advantages and disadvantages over gasoline mechanical drive busses.

Mr. Philip Campbell, technical engineer with the Federal Barge Lines, gave some details of their tugs using Diesel drives.

Mr. R. D. Campbell then answered questions from the floor concerning Diesel engines.

The meeting then adjourned to the usual collation.

A. M. HILL, Secretary-Treasurer.

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AS WE SEE IT

Today the National Defense is of primary concern to members of the Section, and it behooves us to spare a few moments and give thought to the question: How can I as an individual, and as a member of the Louisiana Section, ASCE, best serve the Profession and my Country in its hour of need?

It goes without argument that the Civil Engineer must take the lead in aiding his community to meet the exigencies of the moment. It is he who should aid and direct civic organizations in securing new and essential industries through suggestions as to type of industry best suited to his community, followed by a presentation of these facts to the committees and authorities concerned. In such instances the Section can be of great assistance by suggesting names of leaders in the Profession who are able to serve on various committees with dignity to them-

selves and the Society, and one has but to call on our Secretary for such a list.

One might if connected with defense projects or in need of trained personnel for industry make use of our employment committee. Having the largest available list of both employed and unemployed technical personnel in the State, it is able to serve employer and employee. Yet it is evident that our membership has not availed itself of this service. On record are instances of members urgently endeavoring to secure trained personnel, yet ignoring the services of this committee when its facilities were offered them.

If the above few instances but point the way for each of us to visualize various means whereby we can best serve, then the Section will have fulfilled its obligation to its membership.

NEWS ITEMS

The annual Baton Rouge meeting of the Section was held on October 24th. The Committee in charge of arrangements consisting of Mr. E. L. Erickson, Professor B. W. Pegues and Mr. W. W. Tennant, worked out a program that was of great interest from a technical standpoint. From the social angle it proved thoroughly enjoyable to all present.

Following assembly, at 3:00 P. M., at the Bayou Sara Road gate of the Standard Oil Refinery, an inspection of the new dock, now under construction, was made. At 7:30 P. M. supper was served in the Venetian Room over the L. S. U. Cafeteria, and upon its conclusion the technical program was given in the Physics Auditorium in order that slides might be used to supplement a paper by Mr. C. G. Cappel, M. Am. Soc. C. E., of the W. Horace Williams Company, entitled, "Design and Construction of the Standard Oil Dock at Baton Rouge."

A meeting of the Section is planned for New Orleans during November. An announcement as to details will be issued shortly.

As a result of the Section's activities in connection with National Defense in securing the cooperation of the various Associations and Chambers of Commerce of the State in having cards filled out by all engineers, draftsmen and surveyors in the State, listing their qualifications for service in National Defense, there are on file in our Secretary's Office 295 cards

of employed personnel and 64 cards of unemployed personnel.

Cards were sent to all members of the Section and the Louisiana Engineering Society with the last issue of LASEC NEWS. Members who have not yet filled out and returned their cards are requested to do so immediately.

At the request of the Louisiana Chapter, American Institute of Architects, a committee from the Section is to be appointed to cooperate with them in securing the revision of the New Orleans City Building Code, to bring it up to date. Personnel of this committee will be announced later.

There has been considerable discussion within the membership of the Section for a revision of our Constitution and By-Laws, which do not fulfill the requirements of the Parent Society and are completely out of date. It is desired that members give some thought and study to this question so that at an early date action of the membership may result in the necessary revision. Members desiring copies of our present by-laws for study may secure them upon request to Secretary Bedell.

At the recent meeting in Baton Rouge, a movement to bring to New Orleans one of the four meetings held annually by the Society, rapidly gained momentum. Accordingly, the membership unanimously empowered the Board of Direction of the Louisiana Section to invite the Society to hold the 1942 Spring Meeting in the Crescent City.

George Goodell Earl

(M. Am. Soc. C. E.)

Died at his home at New Orleans, Louisiana, September 16, 1940. Graduated from Lafayette College in 1884, Mr. Earl came to New Orleans in 1892 to design and supervise construction of a sewerage system for the New Orleans Sewerage Company. Upon the formation of the Sewerage & Water Board in February, 1900, Mr. Earl was appointed Chief Engineer and General Superintendent. He then began the development of the modern water purification, water distribution, drainage and sewer systems of New Orleans.

Retiring as active head of the Sewerage & Water Board in 1931, with an enviable record of achievement in the public interest, he was appointed Engineering Consultant to the Board and served with distinction in this capacity until his death.

PERSONALS

Maj. J. LESTER WHITE, former Chairman of State Planning Commission, has been called into active service under the Assistant Secretary of War as one of his two representatives as advisors to the State Selective Service Board on Industrial Deferment.

GEORGE P. RICE was a recent visitor to Washington, D. C.

STANLEY LEVITT (Junior) has resigned his position with the Second New Orleans District, U. S. Engineers, and is now connected with the American Bridge Company in Trenton, N. J.

ELMER E. SHUTTS has recently been appointed as member

of the State Highway Commission by Governor Jones.

S. E. (AL) HUEY has been appointed Acting Chief, State Board of Engineers by Governor Jones.

Col. A. M. SHAW is now located in Alexandria with the W. Horace Williams Company on the construction of Camp Evangeline.

DAVE W. GODAT was a recent visitor to New York City.

While "Civil Engineering" is celebrating its tenth anniversary this month, we wonder how many of our members know that it was launched on its meritorious way during the administration of our own JOHN F. COLEMAN as President of the Society.

In the recent reorganization of the State Board of Health, the Division of Sanitary Engineering with JOHN H. O'NEILL as its Chief Engineer has been given added responsibilities in the safeguarding of the health of the citizens of Louisiana.

Col. EDWARD S. BRES, representing District 15, attended the meeting of the Board of Direction of the Society in Cincinnati on October 14.

DID YOU KNOW THAT:—

The Huey P. Long Bridge over the Mississippi River at New Orleans subsides at high river stages and rises at low stages. What is YOUR explanation of this phenomena?

EMPLOYMENT OPPORTUNITIES

Structural designers, detailers and draftsmen are wanted immediately. Contact George C. Symes, care J. G. White Engineering Corporation, Mobile, Ala.

Applications will be received, until further notice, by the U. S. Ordnance Department, for senior inspectors, inspectors, associates, assistant and junior inspectors of ordnance material.

Engineering Draftsman (Ordnance), various grades, \$1620 to \$2600 a year. Closing date: June 30, 1941. (U. S. Civil Service announcement 73.)

MEMBERSHIP CHANGES

APPLICATIONS FOR ADMISSION:

For Associate:

JOHN I. McCAIN, JR., Baton Rouge, La. (From Junior.)

CHARLES B. SPENCER, New Orleans, La. (From Junior.)

ARCHIBALD D. STANGE-BOSTON, Shreveport, La.

For Junior:

MARTIN M. GURTNER, II, New Orleans, La.

DIETRICH W. JESSEN, from L. S. U.

WILLIAM A. GAMBLE, from L. S. U.

MAYER MAYER, JR., from L. S. U.

HYMAN SAMUELSON, from L. S. U.

ADDITIONS TO MEMBERSHIP:

Associate:

DONALD S. ELLIOTT, New Orleans, La.

CHANGES OF ADDRESS:

E. LELAND DURKEE from Baton Rouge to Bethlehem Steel Company, Bethlehem, Pa.

ERNEST L. EUSTIS, JR., from New Orleans to Ingalls Shipbuilding Corp., Pascagoula, Mississippi.

CHARLES L. GRAVES from Cairo, Ill., to Box No. 244, Franklin, La.

CLARENCE B. KILGORE from Meridian, Mississippi, to Box No. 203, Gulfport, Mississippi.

JOHN O. McLEROY from Dallas, Tex., to Austin Bridge Company, Baldwin, La.

STUDENT CHAPTERS

TULANE UNIVERSITY

The first meeting of the Tulane Student Chapter for the 1940-41 term was held on October 5. The following officers who were elected at the end of the last term were inducted into office:

Wm. R. Burk, Jr., President.

W. O. Hudson, II, Vice President.

J. A. Allison, Secretary.

Paul E. Arbo who had been elected treasurer is now attending the United States Naval Academy. An election was held for this position, resulting in the selection of Bernard H. Grehan, Jr.

Business meetings of the Chapter will be held every second Saturday and it is planned to have prominent engineers visit the Civil Engineering School on alternate Saturdays to address the student body.

LOUISIANA STATE UNIVERSITY

An organization meeting of the Louisiana State University Chapter was held shortly after resumption of class work. At this time the Chapter under the leadership of President B. Greenberg heard several addresses from faculty members and chapter officers and then viewed movies illustrating several outstanding engineering projects. The membership of the Chapter numbers 40 students.

THE PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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JAMES M. ROBERT, Editor.

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Suite 422 St. Charles Hotel

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1st Vice-Pres., B. STANLEY NELSON, 308 Whitney Building.
2nd Vice-Pres., C. W. RICKER, Tulane University.
Sect.-Treas., ARTHUR M. HILL, Tulane University.

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LEO J. LASSALLE, Louisiana State University.
KARL P. KAMMER, New Orleans Public Service.
WADE BARNETT, Sewerage and Water Board.
HORACE E. CRUMP, Dock Board.
DAVID W. GODAT, 7826 Zimple Street.

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President, BOYKIN W. PEGUES, Head of School of Civil Engineering, Louisiana State University.
1st Vice Pres., W. W. TENNANT, Standard Oil Co., Baton Rouge.
2nd Vice Pres., N. E. LANT, Louisiana Highway Commission, Baton Rouge.
Sect.-Treas., C. A. MYERS, Louisiana Highway Commission, Baton Rouge.

Members may obtain key to rooms at hotel desk
All business communications should be addressed to Arthur M. Hill, Secretary, P. O. Station 20, New Orleans, La.

STANDING COMMITTEES FOR 1940

FF PILLER STAND Awards

The last name on each committee is the Junior member, who sits with the committee, but without vote.

Cam Hill

a. J. Harris

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. XXVI.

DECEMBER, 1940

No. 6

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EDITORIAL NOTES AND COMMENT

The Annual Meeting. Mark on your calendar the dates January 10th and 11th, 1941. This is the time of the annual meeting. The general chairman for the coming meeting is Mr. Karl P. Kammer. And when that is said you will know that enough is said to assure everyone a meeting which will lack nothing at all.

A mere glance at the tentative program and the names of nationally known engineers which will appear on it will convince one that the committee has already done a monumental job in securing these speakers. The tentative program follows this article.

We hope all the out-of-town members will be able to attend. We sincerely **urge** you to do so. With the preparations which are being made by the hard working committee we know you will be pleased. We know too you will leave the meeting with a feeling of complete satisfaction with both the technical and entertainment features.

And the ladies? Yes, by all means bring them. The Woman's Auxiliary under the able presidency of Mrs. A. L. Dunlap is making special plans for visiting ladies. We are looking forward to the attendance of a large number of ladies and every provision is being made for their comfort and entertainment.

Let us all make this the biggest meeting ever!

**Tentative Program of
Louisiana Engineering Society
ANNUAL MEETING**

**St. Charles Hotel, New Orleans
January 10, 11, 1941**

Friday, January 10:

"Process in Creosoting Wood"—Mr. Charles M. Kerr,
American Creosote Works, Inc.

K. P. Kammer, presiding officer..

"Science of Seeing"—Dr. Matthew Luckiesh, Director of
General Electric Company's Light Research Laboratory.

Incoming President, presiding officer.

Saturday, January 11:

A. M.—Section A No. 1—

"Problems in Steel Construction"—Mr. Mace H. Bell,
A. I. S. C.

N. E. Lant, presiding officer.

Section A No. 2—

"New Technique in Boiler Design"—Mr. E. G. Bailey,
Vice President, the Babcock & Wilcox Company.

L. J. Lassalle, presiding officer.

Section B No. 1—

“Radiant Heating and Cooling”—Dr. F. E. Giesecke, President of the American Society of Heating and Ventilating Engineers and Professor Emeritus of Heating and Ventilating, A. & M. College of Texas.

G. E. May, presiding officer.

Section No. 2—

“Solving the Dust and Dirt Problem Electrically”—Mr. S. R. Orem, Jr., Precipitron Application Engineer, Westinghouse Electric & Manufacturing Company.

C. S. Williamson, Jr., presiding officer.

P. M.—

“History of Electrical Industry in United States and Its Influence on National Defense”—Mr. F. G. Frost.

E. B. Mabson, presiding officer.

Baton Rouge Section. The Annual Meeting of the Baton Rouge Section was a supper meeting, held in the Venetian Room at L. S. U. on December 12.

After a delicious meal, Prof. Pegues called the meeting to order about 8:15, and welcomed the numerous members and guests.

Mr. E. O. Giffenhogen spoke briefly on the “Reorganization of the State Department.”

Officers were elected as follows:

W. W. TENNANT.....	President
N. E. LANT.....	First Vice-President
F. F. PILLET.....	Second Vice-President
CHAS. A. MEYER.....	Secretary-Treasurer

Mr. Meyer continues in office, having been elected as the first Secretary-Treasurer last year.

The Basket Picnic. On October 6th the Entertainment and Outing Committee led by its able Chairman, Mr. Ole K. Olsen, sponsored an innovation in the form of a basket picnic held at

Camp Salmen. A large crowd of members and their families participated in this delightful event, and while it may have been a loss on the financial side of the ledger, all are agreed that it was indeed a "moral victory." Mr. K. P. Kammer was in charge of the games. The games included badminton, horse-shoe pitching, children's races, a deer race, and a soft ball game. Several prizes were awarded in the various events. The soft ball game appeared to be the most popular of all of the attractions. Everyone who attended agreed that an attempt should be made to keep this basket picnic as an annual event.

Barnard, Godat and Heft. The membership will be interested to learn that three of our members, Messrs. C. C. Barnard, D. W. Godat, and G. A. Heft, have announced their association as partners for the practice of engineering under the firm name of Barnard, Godat and Heft. Their announcement also carries the name of Professor W. B. Gregory as Consultant. We congratulate these gentlemen upon their association and we wish for them a full measure of success in their new venture.

The October Meeting. The October meeting was held at Community House Hall, Reserve, Louisiana. Since the paper of the evening is not in a form in which it can be presented in the "Proceedings" this notice is made of the meeting as a matter of record.

Mr. Walter C. Carey, Senior Engineer of the Second New Orleans District Engineers, spoke on "The Asphalt Mixing and Sinking Plant." In connection with the discussion moving pictures were shown. After these preliminaries the meeting adjourned to the mixing plant on the river, where the actual work could be inspected in operation. After the inspection the usual collation was served. A large number of members attended this meeting and evidenced considerable interest therein.

The November Meeting. On Monday, November 11th the regular monthly meeting was held in the Hunt Room, St. Charles Hotel. Mr. William L. Lehmkuhl, Plant Superin-

tendent of the Flintkote Company, New Orleans, spoke upon "The Utilization of Waste Materials, Evolution of a Local Industry." His discussion was illustrated with motion pictures. We regret that Mr. Lehmkuhl's discussion is not available for this issue of the "Proceedings."

Death of Charles C. Wiggin, Jr. It is with regret that we must note here the death of another one of our members, Charles C. Wiggin, Jr. Mr. Wiggin received his Mechanical and Electrical degree in Engineering from Tulane University in 1924. He joined the Louisiana Engineering Society in 1927. His presence will be greatly missed at the meetings.

A committee has been appointed to draw up resolutions on his death.

Resolution on the Death of R. H. Baumbach

As Chairman of the Employment Committee, R. H. Baumbach served this Society long and faithfully. Through his efforts, many engineers found employment and were started on successful careers.

The automobile accident, which was the immediate cause of his death, brought sorrow to his many friends in the engineering profession as well as the members of his family. We shall miss his genial personality and his friendly council.

Be It Resolved: That the Louisiana Engineering Society feels a deep sense of loss in the passing of our esteemed member, R. H. Baumbach, and expresses its appreciation for his efficient services for so many years.

Be It Resolved: That these resolutions be spread upon the minutes and a copy furnished to the bereaved family.

Signed: R. P. BASSICH,
GEORGE HEFT,
W. B. GREGORY, *Chairman.*

Resolution on the Death of George G. Earl.

On Monday, September 16, 1940, Mr. George G. Earl, Life Member of the Society, passed away after a brief illness of a few days, and within a few weeks of reaching his 77th birthday.

Thus is removed from our midst an outstanding civil engineer identified with the New Orleans Sewerage and Water Board from its organization in 1899 until the day he departed this life. For, while it is true that his active duties as General Superintendent terminated in 1931, his services continued as Consulting Engineer and his advice was sought on many important engineering steps subsequently contemplated and executed by that board.

For more than thirty years he was the directing head and guiding hand in the great undertaking of providing this community with its present modern sewerage system, and its unsurpassed water supply system. Subsequent to the merging of the New Orleans Drainage Commission with the Sewerage and Water Board in 1902, the extension and development of the city's drainage system came under the supervision of Mr. Earl. During that thirty-year period, there were expended in construction on these three systems, under his direction, approximately fifty-one million dollars. The works were skillfully planned, honestly executed, and efficiently maintained, and constitute a tribute to his memory more to be prized than one of monumental marble.

Although he was in the evening of his life, his mental alertness persisted to the end, and he sustained an intense interest in large public questions affecting the welfare of this section of the country. His discussions and views on the subject of transportation on inland waterways always commanded the respect and approval of those he addressed. His comprehensive and convincing briefs in opposition to the St. Lawrence Waterway Treaty and

to the restriction of the Lake Michigan Diversion at Chicago were the militant declarations of a far-seeing economist as well as of a thoroughly informed engineer. The membership of the Society will recall his most recent declarations on these subjects at a monthly meeting of the Society only a short time ago.

Notwithstanding his high attainments and position reached by him in his profession, he was always the same modest, unassuming, genial character that at first endeared him to his friends and acquaintances of many years standing. Of high integrity and capability, he won and held the respect of the community he served. His passing is not only a loss to this Society and to the engineering profession, but is a great civic loss as well.

Be It Resolved: That the Louisiana Engineering Society extend its heartfelt sympathy to the members of his family in their great sorrow, and that this tribute be recorded in the minutes of the Society.

Signed: JOHN KLOMER, *Chairman.*
JOHN T. EASTWOOD,
JOHN L. PORTER.

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Society, September 9, 1940.

The meeting was called to order by First Vice-President Nelson. Approximately 100 members and guests were present.

Prof. W. B. Gregory presented a resolution on the death of Mr. R. H. Baumbach, which is a part of these minutes.

Mr. Ole K. Olsen gave a brief outline of the proposed basket picnic to be held some time in October.

The technical paper of the evening was entitled "Technical Aspects of Fluorescent Lighting." It was written by Mr. J. M. Guillory, and was presented by Mr. H. L. Salaun of New Orleans Public Service, in the absence of Mr. Guillory.

Numerous exhibits were used in demonstrating various points discussed in the paper.

Following the presentation, questions were asked from the floor.

The speaker was tendered a rising vote of thanks, after which the meeting adjourned to the collation.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Board September 20, 1940.

The meeting was called to order by President Rhodes with the following present: Kammer, Nelson, Ricker, Hill.

The first matter of business considered was that of the members and vacancies of the Board of Engineering Examiners.

With the collaboration of those present, a letter was drafted to be sent to the Governor in connection with recommendations as to the members of the Board.

A letter was presented from the American Engineering Council concerning action recently taken by the American Society of Civil Engineers.

The following committee was selected to present a resolution at the next meeting on the death of Mr. George Earl: John Klorer, Chairman; John L. Porter, J. T. Eastwood.

Mr. Karl Kammer was unanimously elected as General Chairman of the General Committee of the 1941 Annual Meeting.

There being no further business, the meeting adjourned.

A. M. HILL, Secretary-Treasurer.

Meeting of the Board of Direction, October 14, 1940.

The meeting was called to order by President Rhodes with the following present: Kammer, Ricker, Hill, Godat.

A letter was presented asking that a Community Chest speaker be allowed a few minutes time at the next meeting of the Society.

A letter from the Louisiana Chapter of the American Institute of Architects was read. It asked that the Society cooperate with this and other interested bodies in reviewing and suggesting changes in the building code. It was voted to appoint a small committee.

Mr. Karl P. Kammer made a brief report on progress in establishing a group of junior engineers in New Orleans.

Names were suggested and the following agreed upon for the membership of the nominating committee: D. W. Godat, Chairman; A. L. Dunlap, A. T. Dusenbury.

There being no further business, the meeting adjourned to the Community Hall.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of October 14, 1940.

The meeting was called to order in the Community House Hall, at Reserve, La., by President Rhodes. Approximately 50 members and guests were present.

The reading of the minutes of the previous meeting was dispensed with.

Mr. Charles A. Myers, Secretary-Treasurer of the Baton Rouge Section, was introduced.

The Secretary read a resolution on the death of Mr. George Earl, prepared by Messrs. Klorer, Eastwood and Porter.

Mr. Karl P. Kammer gave a brief report on the progress made toward the establishing of a junior engineers' group.

Mr. Ole K. Olsen, Chairman of the Entertainment and Outing Committee, reported on the picnic held at Camp Salmen on October 6. About 165 attended, and it was a very successful event.

Mr. Walter C. Carey, Senior Engineer, Second New Orleans District Engineers, spoke on "The Asphalt Mixing and Sinking Plant." This was followed by a movie, showing all phases of operation.

The meeting then adjourned to the plant on the river, and the various operations were witnessed. All present found the trip extremely interesting and informative.

Following the trip, the party returned to the Community House, where sandwiches and beer were served.

A. M. HILL, Secretary-Treasurer.

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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

DECEMBER, 1940

"PATRONIZE OUR ADVERTISERS"

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LASEC NEWS

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December, 1940

AS WE SEE IT

As an organization devoted to the technical and economic interest of its membership the Section arranges for the presentation of a paper, on some topic of interest, at each of its meetings. These papers have been noteworthy for their character and composition and the time and effort devoted to their preparation.

Recognition of the authors' efforts has been through applause and commendation at the meeting, and occasional publication of the paper in the Proceedings of the Louisiana Engineering Society. Is it not time that the Section treat these papers with a dignity more in keeping with their value? Other Sections of the Society and our parent Society, as well, offer various awards for papers presented in order to stimulate interest in and encourage the preparation of papers.

The Louisiana Section offers but one award, and that a scholarship to a member of each of the two

Student Chapters. Why not offer an award for presentation of a paper by a Corporate Member, and in order to encourage our Juniors—one for the best paper presented by a Junior Member. A standing committee of the Section could be appointed each year to select the outstanding paper presented during the year and at our annual meeting, an announcement made of its selection and a citation or medal presented the author. This will stimulate interest in preparation of papers, annual meetings, and publicity efforts and ultimately serve as an incentive to the Section to sponsor publication of its own papers.

It is the hope of your Publicity Committee that this suggestion will be given serious consideration by the membership at our forthcoming annual meeting and result in action that will denote the ability of the Louisiana Section to stand on a par with any other Section of the Society.

NEWS ITEMS

An enthusiastic meeting of the Section was held at the St. Charles Hotel in New Orleans on the night of November 25th. Following a brief business session, at which time a resolution in connection with revision of the By-Laws was adopted, a paper was presented by Dr. Glenn N. Cox, Assoc. M. Am. Soc. C. E., Professor of Mechanics and Hydraulics, Louisiana State University. In his paper Dr. Cox showed that through correlation of data involving dimensionless numbers, the study of the flow of water through pipes, orifices and weirs can be used to determine the corresponding actions of other fluids and gases.

The meeting was marked by an exceptionally large attendance of Louisiana State University and Tulane Student Chapter members.

The NEXT MEETING of the Section will be held at 9:15 A. M., Friday, January 10, 1941, in connection with the Sixth Annual Meeting of the Louisiana Engineering Society at the St. Charles Hotel. Announcement of the speaker and subject of the program will be made later.

The Scholarship Award Committee has announced that the recipient of the award for this year at Louisiana State University is John E. Johnson, Junior in the Civil Engineering School, and at Tulane University the award was made to George Seaver, a Sophomore in the School of Civil Engineering.

Professor Donald Derickson, faculty advisor of the Tulane University Student Chapter, is in receipt of a letter of commendation from President Hogan, advising that the Tulane Chapter has again been selected as one of the twelve Student Chapters whose work for the past school year has been found worthy of special mention.

In his letter President Hogan says: "It gives me particular pleasure to note that this is the sixth consecutive year — every year since the establishment of the awards—that the Committee on Student Chapters has recommended the Tulane Chapter for commendation. This is a matter for justifiable pride on the part of everyone connected with the Chapter during these years, as it is on the part of the Society."

President Lant has appointed a committee consisting of F. N. Billingsley, Chairman; Mace H. Bell, Donald Derickson, B. Dornblatt and Geo. P. Rice, to meet with a committee of the Louisiana Chapter, American Institute of Architects on revision of the Building Code for the City of New Orleans. A meeting of this committee was held on December 2nd, at which time recommendations were made and a sub-committee appointed to formulate a resolution to the City Council recommending the adoption of the Uniform Building Code of the Pacific Coast Building Officials Conference, with modifications for local conditions.

A very interesting booklet has been written by Col. A. M. Shaw on "The Metairie Sewer System."

Col. Shaw was P. W. A. Representative on this project.

The Board of Direction, Louisiana Section, has been appointed by President Lant to serve as a committee to secure the 1942 Spring Meeting of the American Society of Civil Engineers for New Orleans. This committee has the active cooperation of the New Orleans Association of Commerce and anticipates the support of the Texas and other adjoining Sections in a successful culmination of its efforts.

The date of the REGULAR ANNUAL MEETING of the Louisiana Section in New Orleans at the home of Ole K. Olsen, 508 Millaudon Street, has been tentatively set for the night of January 24, 1941. The transaction of the usual business of the Section will be followed by an exceptionally interesting technical paper by one of the nation's outstanding engineers.

As those members who have attended this meeting in the past well know, the gathering in Ole's Rathskeller following the meeting is a lively occasion, and one long to be remembered. Members from out of the city should by all means avail themselves of this opportunity to enjoy a fitting climax to the Holiday Season.

PERSONALS

CYRIL G. MELVILLE is now connected with the W. Horace Williams Company on the construction of Camp Claiborne near Alexandria.

F. N. BILLINGSLEY is on an Association of Commerce committee to investigate costs of building construction in New Orleans and is also on their Nominating Committee for appointment of twelve new directors.

GEORGE R. CLEMENS, Senior Engineer with the Mississippi River Commission, is now on active duty with the Army as a Major in charge of construction of the Camp Beauregard Airport.

E. F. SALISBURY, Chief Engineer of the L. & A.—K. C. S. Lines, is located in Shreveport since the removal of the engineering offices from Minden.

We were glad to see LAZARUS TODD of the Second Area, U. S. Engineers, who came down from Melville to attend the Baton Rouge meeting.

Also noted at the Baton Rouge meeting was C. D. EVANS, formerly of Shreveport.

R. B. FOWLER of Alexandria, former State Director of Operations, W. P. A., is now engineer for the Louisiana National Guard in connection with construction of the Observation Squadron Base at New Orleans Airport.

Congratulations to D. W. GODAT and G. A. HEFT in the formation of the new firm of Barnard, Godat and Heft, Consulting Engineers.

Congratulations to WM. B. GREGORY, Professor of Hydraulics, Tulane University (Retired),

on his selection as the recipient of the Worcester - Reed - Warner Medal of the American Society of Mechanical Engineers for his "contribution to permanent engineering literature."

STUDENT CHAPTERS

Louisiana State University

In addition to the regular monthly meeting of the Chapter a field trip was made to inspect the new sewer system being built by W. P. A. at Istrouma, where methods of staking out and laying of pipe were observed.

More recently the Chapter attended the meeting of the Louisiana Section held in New Orleans on November 25th.

Tulane University

The Senior class in Civil Engineering made a field trip over the Thanksgiving Holidays to the U. S. Engineers Waterway Experiment Station in Vicksburg, to inspect experimental work going on there.

Additional inspection trips were made to construction operations at the Jackson Brewing Company Plant and to the new Walgreen Drug Store in New Orleans. The Chapter also attended the Louisiana Section meeting in Baton Rouge last month.

On November 29th, Lt. Col. Frederick H. Fox, Louisiana National Guard, a member of the faculty of the School of Civil Engineering, gave a talk to the student chapter on "The Young Engineer's Place in Military Service."

MEMBERSHIP CHANGES

CHANGES OF ADDRESS

CLIFFORD L. MORGAN, Ludington, Mich., to Box 1032, Alexandria, La.

JOHN H. PORTEUS, New Orleans, to Bradford Hotel, Boston, Mass.

EMPLOYMENT OPPORTUNITIES

Positions available will not be listed in this issue. In lieu thereof we wish to make the following announcement in behalf of the Employment Committee of the Section:

"Due to the recent boom in construction activities the Committee finds it necessary to abandon its present files of applications. This step has been occasioned by the fact that numerous applicants have secured new employment without notification to the Committee, resulting in uncertainty as to the status of applications now on file.

Effective with this issue of LASEC NEWS members seeking employment or who wish to change their present employment, and employers seeking men, must submit new applications or advise G. A. Heft, Secretary Employment Committee, P. O. Box 1240, New Orleans, to continue their present applications in an active status."

DID YOU KNOW THAT:—

The New Orleans Sewerage and Water Board pumping station on the Metairie Outfall Canal near Lake Pontchartrain has the greatest capacity of any drainage pumping station in the world?

