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OF THE

LOUISIANA ENGINEERING SOCIETY

VOL. VII. 1921

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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

CONTENTS

EDITORIAL NOTES AND COMMENT: PAGE

Address of the Retiring President 5
Costs 147
Delgado Trades School, The 187
Dye and Coal Tar Industries in the United States 217
Elimination of Waste in Industry 113
Engineers on the State Board Health 83
Federal Aid in the Construction of Public Roads 112
Financing a System of State Highways 82
Forest Conservation in Louisiana 111
Hurricane Engineering 5
Hydraulic Turbine, The 145
Industrial Canal, The 185
Informational Service Concerned with Metals and Alloys, An 7
Meetings of the A. S. M. E. 7
Membership Campaign, The 213
Military Engineer, The 148
Natural Gas for New Orleans 211
New Members 84, 114, 216
New President, The 3
Note on Unemployment, A 189
Personal Mention 8
Proceedings Abroad, The 83
Restoring Devastated France 215
Several Kinds of Engineers 214
1921 Smoker, The 6
Some Facts About the Telephone 113
Straightening a Turbo-Alternator Shaft 81
Suggested Removal of our Library 84
U. S. Coast and Geodetic Survey 4
Wood Preservation 147

IN MEMORIAM 89

OBITUARY 192

PAPERS AND DISCUSSIONS:

"Certain Features Relating to Hydraulic Turbine Design and Settings." *By E. W. Burbank* 150

"Contracting Engineer, The—A cog in the Wheel of Industry." (Address of the Retiring President) *By John Riess* 25

"Federal Aid in the Construction of Public Roads." *By Henry C. Cooley* 123

"Hurricane Engineering." *By Charles Evan Fowler* 33
"Industrial Canal, The." *By Walter Parker* 193
Discussion 205
"Natural Gas for New Orleans." *By A. M. Lockett* 218
Discussion 231
"Organization and Work of the U. S. Coast and Geodetic Survey, The." *By E. B. Latham* 10
"Road Financing." *By Harry P. Gamble* 92
Discussion 100
"Straightening a Large Shaft by the Heat Process." *By Frank G. Frost* 85
"Waste in Industrial Process." *Issued by the American Engineering Council* 133
"Why Louisiana Conserves Her Forests." *By R. D. Forbes* 115
"Wood Preservation." *By Henry E. Rodrigues* 174

CATALOGUE OF LIBRARY 51

MEMBERSHIP LIST FOR 1921 41

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY:

Minutes of Board of Direction, December 13, 1920 67
" " " January 8, 1921 107
" " " February 14, 1921 107
" " " March 14, 1921 108
" " " April 11, 1921 141
" " " May 9, 1921 143
" " " June 13, 1921 182
" " " September 12, 1921 209
" " " October 10, 1921 242
" " " November 14, 1921 242

Minutes of the Society, December 13, 1920 67
" " " January 8, 1921 107
" " " February 14, 1921 108
" " " March 14, 1921 109
" " " April 11, 1921 141
" " " April 18, 1921 142
" " " May 9, 1921 143
" " " June 13, 1921 183
" " " September 12, 1921 209
" " " October 10, 1921 242
" " " November 14, 1921 243

Annual Report of the Secretary for 1920 69
Annual Report of the Treasurer for 1920 76

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PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

VOL. VII FEBRUARY, 1921 NO. 1

CONTENTS

EDITORIAL NOTES AND COMMENT: PAGE

The New President 3
The U. S. Coast and Geodetic Survey 4
Address of the Retiring President 5
Hurricane Engineering 5
The 1921 Smoker 6
Meetings of the A. S. M. E. 7
An Informational Service Concerned with Metals and Alloys 7
Personal Mention 8

IN MEMORIAM 9

PAPERS AND DISCUSSIONS:

The Organization and Work of the U. S. Coast and Geodetic Survey. *By E. B. Latham* 10
The Contracting Engineer — A Cog in the Wheel of Industry. (Address of the Retiring President) *By John Riess* 25
Hurricane Engineering. *By Charles Evan Fowler* 33

MEMBERSHIP LIST 41

CATALOGUE OF LIBRARY 51

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY 67

ANNUAL REPORTS 69

EDITORIAL NOTES AND COMMENT

The New President. That the Louisiana is in line for another year of prosperity and progress is evidenced by the election at the last annual meeting of Mr. Rufus S. Manley as President for the 1921 term.

Rufus S. Manley was born in Junction City, Kans., September 27th, 1878, and resided at that place until 1897, having graduated from High School that year. He attended the

United States Naval Academy from 1897 to 1901, at which time he graduated. From 1901 to 1906 he served in the Navy on various vessels, both in the Engineering Departments and in the line. In 1906 he resigned and very shortly thereafter became identified with the Gulfport Creosoting Company, supervising the construction of the Creosoting Plant at Gulfport and managing the Gulfport Creosoting Company until 1911.

From 1911 to 1914, as President of the Creosoted Wood Block Paving Co., he was engaged in the extension of the use of Creosoted Wood Blocks and in the construction of Creosoted Wood Block Pavements. During the war with Germany, he again entered the Navy in the Fleet Reserve as Lieutenant and was promoted to Lieutenant Commander in the Reserve, which rank he now holds.

Mr. Manley has been a resident of New Orleans for the past ten years and has always taken a prominent part in the business and social life of the city. He became a resident member of the Louisiana Engineering Society in 1912, and has always been active in its affairs. He served as Vice-President last year.

The U. S. Coast and Geodetic Survey. In a paper read before the Society at its December meeting, Capt. E. B. Latham gave a very interesting and instructive outline of this most important bureau of the National Government. The paper is printed in full in this issue of the Proceedings. In point of history the Coast Survey is over one hundred years old, having been established by act of Congress in 1807. It was for many years a division of the Treasury Department, but is now one of the bureaus of the Department of Commerce. The personnel consists of civilian employees, with a Director as head of the organization. There as, in addition to the main office at Washington, six field stations, located respectively at Boston, New York City, New Orleans, San Francisco, Seattle and Manila, P. I. Each of these stations is in charge of an Inspector.

The wide scope of the organization and work of the Bureau may be understood from the list of activities given below, and which are included in the work of the Divisions of Geodesy, of Hydrography and Topography, and of Magnetics. A description of the principal methods used in each case is set forth in Capt. Latham's paper. Under these divisions are included determinations of Gravity, Latitude, Longitude, Azimuth, Triangulations and Precise Levels; also Details of Shore Line. Soundings in Harbors and Adjacent Waters, Tides and Ocean Currents, Magnetic Declination, Inclination and Horizontal Intensity.

Address of the Retiring President. There is much matter for serious consideration and thought in the address made by Mr. Riess, retiring President, at the recent annual meeting of the Society. His subject was the Contracting Engineer, a definition of the meaning of the term, an outline of his proper field of activities and his relationship and duty toward labor. The contracting engineer is a professional specialist in the work of construction. At the same time he must be a thorough business man conversant with the modern methods of efficient and economic construction. Mr. Riess believes that it is to the Contracting Engineer that the world must look for a satisfactory solution of the problem of the conflict between capital and labor. He should be a specialist in the management of labor and should have a voice in constructive legislation for the good of the laboring man.

Hurricane Engineering. Under this title we are glad to be able to publish in this issue a discussion of Dr. Cline's recent paper on "Relations of Changes in Storm Tides on the Coast of the Gulf of Mexico to the Center and Movement of Hurricanes." The discussion has been submitted by Mr. Charles Evan Fowler, Consulting Engineer of New York City, and as the title implies, it stresses the need for more extended observations and better data on storm tides and hurricanes for the benefit of engineers who have to do with the design and construction of structures which will withstand the effects of these storms.

The 1921 Smoker. About this time last year we wrote a short editorial note on the smoker of 1920, pointing out the fact of how successfully it was carried out in spite of the limitations imposed by prohibition. To insure an equal, even if not a like, degree of success for this year's function, the President very wisely appointed a Smoker Committee composed of a Conservative, a Liberal and a Radical; Walter Moses, Ole K. Olson and Major W. B. Gregory. You may make your own classification as to the conservatism, liberalism or radicalism of the committee members in the matter of the conduct and ethics of smoker entertainments.

And so, firm in the faith that somewhere or somehow the above named excellent committee would find the wherewithall to make the event a lively and successful one, a large and representative delegation of the Society's membership hied themselves to Francois' Restaurant on the evening of January eighth to see what they would see. And—they were not disappointed! Ole K. Olsen was Master of Ceremonies, Walter Moses was General Factotum and Major Gregory was in Bogalusa. No sooner were all seated with head-gears adjusted than the waiters hurried in bearing great trays filled with glasses of—ye shades of prohibition—cocktail.

Then there arose in all his majesty one of our most eminent and distinguished engineers and said, in the unavoidable absence of the third member of the Committee, and knowing as he did full well his sentiments concerning this scandalous infraction of the letter and spirit of the prohibition law, he desired in he name of his absent friend to protest against these cocktails. There was no second to this protest, but in that spirit of fair play which characterizes this Society, Mr. Olson put it to vote whether the cocktails should be drunk. The vote was almost overwhelmingly in the affirmative, only the original protestant and a lone Tulane professor, whose character for sobriety is so well known, voting in the negative.

If you were there you know the rest of the story; if not, ask your friend who was there. The letter "T" is a necessary part of cocktail; these cocktails were "T" first, last and always.

One of the most attractive features of the evening's entertainment, aside from the display of Terpsichorean agility on the part of one of our elders, was a telephone booth in which was given a demonstration of one of the latest developments in the field of long distance telephony. We are told it was possible with the apparatus installed to get into connection with a certain Canadian Club within the very short interval of about ten seconds.

The serious part of the entertainment was furnished by the various speakers who were called upon by the toast-master, they having been notified in advance that they were expected to make very witty speeches.

The invited guests included among others, Commander L. F. Billinger, Dr. A. B. Dinwiddie, Col. W. S. Patrick and Mr. Robert Glenk.

Meetings of the A. S. M. E. There will be a joint meeting of the Birmingham, Atlanta and New Orleans Sections of the American Society of Mechanical Engineers at Mobile, Alabama, on April 22nd. This meeting will be attended by the President of the Society, by about fifteen members of the Council, as well as by other prominent engineers from the North and East.

Dr. W. E. Winship will present a paper on "Fuel Oil Problems of the South," and a visit of inspection will be made to the plant of the Chickasaw Shipbuilding and Car Company.

All members of the Louisiana Engineering Society are cordiaaly invited to attend this meeting.

May 23rd through 26th has been set as the date of the Spring Meeting of The American Society of Mechanical Engineers. It will be held in Chicago at the Congress Hotel.

Sessions are planned by the Professional Sections on Aeronautics, Fuels, Management, Material Handling, Machine Shop, Power, Forest Products and Railroads.

An Informational Service Concerned With Metals and Alloys. An Alloys Research Association is being formed with an Alloys Informational Service as the first step. This is to be co-operative on the part of those interested in metals and their alloys. An Advisory Committee, composed of 17 prominent technical men, was formed sometime ago and this Committee has evolved a plan, in conference with the Institute of Metals Divisions of the American Institute of Mining and Metallurgical Engineers, whereby a Service of a different scope from any now existing can be carried on for the benefit of the alloy men. It has been felt that it is time to broaden the sources of knowledge and to have a co-operative Service that will critically and analytically digest the great mass of data that has been accumulated, but is now largely inaccessible. Technical men have not the time to spend in searching even all of the current literature. It is now planned to create a special scientific staff composed of a director and a corps of assistants who will give all their time to rendering a Service of two distinct types: (1) Current Information Service—supplying information as to new results; (2) Reference Service—supplying as fully and promptly as practible all existing information relating to any phase of a subject. The Board of Managers, appcinted by three of the divisions of the National Research Council, is constituted of Mr. Alfred D. Flinn, Secretary of the Engineering Foundation, Dr. R. B. Moore of the Bureau of Mines, and Mr. W. M. Corse, Secretary of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers.

Co-operation and information can solve many of our problems. The first act of the Administration at the great industrial research laboratory at Grosslichterfelde is to put the inquirer abreast of the literature of the whole world and the claim is made that 80% of the problems referred to that Great German central laboratory can be answered by existing recorded information to which the great card catalogue there furnishes the key.

The Research Extension Division of the National Research Council, Washington, D. C., which is aiding in the organization, will be glad to supply fuller details about this Service.

Personal Mention. Mr. James Lowe, formerly representative in this city of the Midwest Engine Co., has severed his connection with that Company and is now located at Harrisburg, Penn., where he is General Sales Manager of the well known Harrisburg Foundry and Machine Works.

In Memoriam

Arsene Perrilliat

The Louisiana Engineering Society having, through the death, on the 23rd day of October, 1920, sustained the loss of one of its most eminent members, Arsene Perrilliat, it desires to herein record its great sorrow for the sad occurence.

He was exceptionally distinguished in professional, commercial, public, social and private life, and as student, scholar, scientist and patron of Art, stood high in the estimation of all who had been fortunate enough to know him and to have been brought in contact with him and his many accomplishments and activities.

Combined with all this, a most gracious, generous and courteous personality always marked his intercourse and association with his fellowman to such an extent as to ever greatly endear him to all.

As greatly as his passing away from our midst may be grevioulу felt by the members of the Louisiana Engineering Society, it can, of course, be in no way compared with that of his bereaved family, to the members of which we beg leave to herein extend our most heartfelt sympathies in their hour of great affliction.

Frank M. Kerr,
Gervais Lombard,
G. W. Lawes,
Committee.

PAPERS AND DISCUSSIONS

THE ORGANIZATION AND WORK OF THE U. S. COAST AND GEODETIC SURVEY.

By E. B. Latham,

Inspector New Orleans Field Station, U. S. Coast and Geodetic Survey.

Read before the Society, December 13, 1920.

The establishment of a National Coast Survey, by Congress in 1807 was the beginning of the present Bureau of U. S. Coast and Geodetic Survey of the Department of Commerce. Ferdinand Hassler submitted a plan of organization for a Coast Survey in 1807 but nothing was done until 1811, at which time Dr. Hassler proceeded to Europe to arrange for instruments and to obtain standards of length, etc.

The war of 1812 prevented the begining of survey operations. The first field work was done in the year 1816, work was suspended in 1818 and resumed again 1832.

In 1871 the scope of the work was extended to that geographic positions and azimuths could be furnished for state and other surveys. In 1878 the Bureau was designated the Coast and Geodetic Survey; a Bureau of the Treasury Department. The Bureau remained in the Treasury Department until the organization of the Department of Commerce and Labor in 1903. to which it was then transferred, finally becoming a Bureau of the present Department of Commerce in 1913. In the reorganization of 1843 the field work was done by Civilian, Army and Naval Officers. In 1861 the Officers of the Army were withdrawn as were the Naval Officers in 1898. In 1900, Congress directed the organization of the Bureau as a Civilian Organization. The present organization consists of a Director and Commissioned Officers, appointed by the President and confirmed by the Senate as Hydrographic and Geodetic Engineers and Junior Hydrographic and Geodetic Engineers and Aids.

This Corps is recruited from the Deck Officer class. Deck Officers are required to hold a degree from a standard Technical School, to pass a mental examination by the Civil Service Service. After appointment and service of not less than six Commission and to be passed physically by the Public Health months, they are eligible for Commissions as an Aid, with the pay and allowance of an Ensign or 2nd. Lieutenant of the Army.

The grades of Mate and Chief Engineers, Officers who serve aboard the vessels of the Survey are appointed from eligible lists selected from persons holding Marine Officers Licenses under the Steam Boat Inspection Service.

Surgeons are selected from those passing examinations prescribed for these Officers. The crew of vessels are enlisted, in general for one year or for the duration of the cruise. The men in the shore parties are employed by the Chief of shore Parties. Magnetic Observers are selected after examination and certification by the Civil Service Commission and are not comsioned.

Operations in the field are conducted under the direction of Commissioned Officers on board vessels and ashore. Preliminary Computations and plotting of field work is done in the field to show that the results obtained are satisfactory. The Bureau maintains six Field Stations, with Inspectors in charge at Boston, New York, New Orleans, San Francisco, and Seattle, with a Station at Manilla, P. I. The Officer in charge of the Manila Station is designated Director of Coast Surveys for the Philipine Islands and has charge of all parties and work in the Islands. The organization is headed by a Director, he and the Assistant Director and the Chief of Divisions, head the ministrative force of the Survey.

For convenience of administration the operations of the main office at Washington is carried on by four technical divisions, in charge of Commissioned Officers, a division of Accounts and the office of Chief Clerk.

DIVISION OF GEODESY FIELD OPERATIONS.

Gravity, Astronomical, Latitude, Longitude, Azimuth, Triangulation and Precise Leveling operations are directed by this Division.

The first measure of the curvature of the earth was made in the second century before Christ, and it is remarkable that the principle then employed is still in use.

Essentially the determination of the distance, between two points, north and south of each other, and their difference in latitude, gives the necessary data, to complete the radius and circumference of the earth. Modern Geodesy began with the discovery of gravitation and has been developed by astromical and other observations.

All primary arcs of triangulation furnish data for the computation of Geodetic factors.

The total length of all arcs of primary triangulation in the United States is about 14,000 miles—more than half the circumference of the earth. The Clark Elipsoid of 1866 adopted by the U. S. Coast and Geodetic Survey in 1909, is the base for all charts of this survey, as well as the maps of other Government organizations.

The largest arc in the United States is that extending from Cape May, N. J., to Point Arena, California, a distance of 4,225 kilometers or 2,625 statute miles.

In July 1919, the International Research Council was organized at Brussels.

Under this council, have been created several unions, one being the International Geodetic Geophysical Union. This organization will take over the work of the old International Geodetic Association.

GRAVITY.

The pendulum is the most convenient as well as the most precise means of measuring Gravity. The Coast Survey Gravity Observations are made to determine the relative gravity at different Stations, rather than to determine its absolute force.

The Coast Survey base Station, is in the Coast Survey Building at Washington and its value of gravity, was determined by the relative method from Potsdam, Germany, so that all values of gravity in the United States are referred to the absolute measures at Potsdam. The gravity apparatus now in use consists of three ¼ meter ½ second pendulums, an air tight base case, in which the pedulums are swung, a telescope for observing the oscillations, two chronometers, several thermometers, a manometer for measuring the air pressure in the base case, and an interferometer, for measuring the movement of the case caused by the swinging of the pedulum.

The pendulum is a stem and bob of solid bronze, with an agate plate attached to its head which rests on a knife edge in the case, on which it oscillates.

During the observations the air pressure is reduced to less than one tenth of one atmosphere, within the case. The resistence is so small that the initial arc of vidration of one fifth of an inch, will cause the pendulum to oscillate for more than twelve hours.

The period of oscillation is observed and compared with the chronometers at the begining and end of each twelve hour swing, and from these comparisons, the average period is computed. The pendulum is so constructed that it makes one less oscillation than the number of half seconds registered by the chronometer. A mirror attached to the head of the pedulum and a fixed mirror enable the observer, by observing two or more consecutive coincidences of rays of reflected light, to deduce the period of oscillation of the pendulum.

The error in the rate and error of the chronometers must be determined within a few hundredths of a second, at both begin and end of the observations. Results to be acceptable must have a probable error of one in two hundred thousand or less. such accuracy is not easily conceivable, but is attained with no great difficulty by an experienced and skilled observer. An idea of the delicacy of these measurements may be had from the fact that a correction of one millionth of a second is applied for flexure.

ASTRONOMICAL WORK—AZIMUTH.

Two orders of accuracy of an Azimuth are observed by this Service. Observations are generally on Circumpolar Stars, but may be observed from any Celestial object. The Azimuths in Magnetic work are generally from Solar observations.

Primary Azimuths. Observations are with a 12 inch direction theodolite, in 12 to 16 positions, the observations may be completed in one night and the probable error of the determination required is 0.5″. At La Place Station (at which Triangulation angles, Lattitude, Longitude, and Azimuth are observed) the probable error required is 0.3″.

Tertiary Azimuths. These are measured with a seven inch theodolite reading to ten seconds, 6 sets are measured each set consisting of 12 pointings. Six repetitions of the angle, star to mark, and six repretitions of the angle, mark to star. The probable error required is 1 second.

Measurements with instruments equipped with ocular micrometers are made by placing the mark so that the star and mark will fall at different elevation of the telescope within the field of the instrument and the angular distance between a star and the mark determined by micrometer readings.

LONGITUDE.

This is the angular distance to the east or west of some adopted initial meridian. This may be be expressed in degrees, minutes and seconds of arc or in hours, minutes and seconds of time. The determiniation of the longitude of a place consists in determining the difference between the local siderial time of the place and the local siderial time of another place, where the longitude is known.

The methods in use, are telegraphic or wireless method and by carrying of chronometers between the Stations, to be determined.

Telegraphic and Wireless Method Observations are made on three nights, no exchange of observers is made. On each night 24 stars are observed, in sets of 6 stars each. Signals are exchanged between the second and third sets, by means of these signals the time indicated by the chronometers at each station is compared. When the chronometers are corrected to local siderial time the difference is the difference in longitude. The cost from 41 Stations recently observed is $140.00 per Station.

The transit micrometer is a form of registering micrometer with a movable wire set in the focal plane of the astronomical transit, moving in the direction of the image of the .star, certain contact points on the head of the micrometer cause a record to be made on a chronograph when the micrometer wire reached certain positions. When the image of the Star reaches a point well within the field of the telescope, the star is kept bisected as it crosses the field of the telescope. As the wire reaches certain positions the contact point on the micrometer head causes a record to be made on the chronograph, the telescope is shifted so that the image of the star passes between two horizontal wires near the center of the field of the transit as it progresses through the field. The accuracy to be obtained by the telegraphic method, by experienced and highly skilled observers is illustrated by the results obtained between Far Rockaway, New York, Cambridge, Mass., and Washington, which were as follows:

Far Rockaway, N. Y.—Washington..........0.0028 seconds.
Cambridge, Mass.—Washington....................0.0024 seconds.
Cambridge, Mass.—Far Rockaway, N. Y.,0.0031 seconds

Ordinarily the probable error required is two hundredths of a second.

Key Method. In an Astronomical transit with a diaphram, the star's image is noted and an observing key is pressed and the time recorded on the chronograph, as the image of the star reached successive wires of the diaphram. Comparisons of time at the two Stations as in an instrument equipped with a transit micrometer may be obtained by this method with a probable error from 0.1 to 0.01 seconds. In the eye and ear method, a similar diaphram, to that used with the Key method, but one having fewer wires, is used. The time of each successive transit of the image of the star over the wires is noted and recorded by carrying the count of the beat of the chronometer. A probable error of 0.1 seconds may be obtained.

LATITUDE.

Practically all latitudes are observed with the Zenith telescope, and by the Talcott method. This consists of measuring the small differences of Meridional Zenith distance between two stars, culminating about the same time, on opposite sides of the Zenith. The required probable error of the mean result is 0.11, at least 10 pairs of stars being observed. The telescope is set so that the two stars will show in the field at culminations, when the telescope is turned 1800 in zenith. The thread of the micrometer is set to bisect the image of the star when it is near the middle of the field, the micrometer and levels are read and recorded, the telescope reversed for the second star of the pair, and this process repeated for the second star. The difference in declination, as determined by the micrometer readings, corrected for level readings, give the data for computing the latitude.

At 63 Latitude Stations observed between 1905 and 1908, at which 167 pairs of stars were observed the probable error was 0.1″. At seven Stations observed in eight nights in 1908, the probable error was 0.08″.

In the Latitude observations made by the International Geodetic Association, to determine the variation in Latitude which were supervised in the United States by the Coast Survey Organization, a photographic method; a modification of the Talcott Method, was used.

BASE LINES.

These are now measured with standard Invar metal tapes, which are standardized both before and after the field season. The practice of measuring with bars while giving a high degree of accuracy is slow and of great cost.

The measures with the present style of tape is of ample accuracy. The coefficient of expansion of this metal is 0.000,000,4 or about one twenty-fifth of that of steel.

The tension applied to tapes is 15 kilograms or 33.1 pounds. A base party consists of one officer and four unskilled hands. The cost of the measures is $50 per kilometer. The accurcy required is 20mm. multiplied by the square root of the distance in kilometers. Primary traverse is largely used in flat heavy wooded areas, in lieu of triangulation. The accuracy of the results compare favorably with the results obtained in primary triangulation.

TRIANGULATION.

Triangulation is of three degrees of accuracy.

Primary. Required accuracy; triangles are to close within one second for each triangle, when all of the angles are observed and is used where an arc is to be extended over great distances. Twelve inch theodolites are used on this class of work. Observations are generally made at night on specially designed lamps. Heliotropes are used on lines observed during daylight.

The line Mt. Shaster, Mt. Helena, in the California coast triangulation is more than 190 miles long and is the longest terrestrial line as yet observed by man.

Secondary. This class of work should close with an average of from two to three seconds when all the angles of a triangle are observed and its lines are from one to fourteen miles in length. Eight to ten inch repeating theodolites, and 8 inch direction instruments are used in this class of work.

Tertiary. The degree of closure for this class of work is from three to five seconds for each triangle, when all the angles of a triangle are observed. This is readily obtained with a seven inch theodolite reading to ten seconds and by observing six repetitions of each angle and six repetitions of its explement, and closing the horizon around each Station and distributing the closing error of the horizon. This class of triangulation is used for the control of topographic and hydrographic surveys, and is specified unless otherwise directed for all triangulation along rivers and around harbors in the United States and its possessions.

In all classes of triangulation, done by the Coast Survey, the length of the go ahead line must be computed through two independent sets of triangles, that is, a single triangle is not acceptable in computing a new base.

Computation of the Triangulation. Field Parties compute the triangle's sides in the field to be sure no large errors of observation or recording have been made, that is errors of several seconds, minutes or degrees. Before the results of a triangulation are given to the public a least square adjustment is made in the Washington Office to determine the most probable values of lengths, angles, Azimuths, Latitudes and Longitudes. In special cases, the field results are furnished engineers and others who may have urgent and immediate need for the results, but those furnished the field results are warned that the results are from field computations and are subject to revision.

PRECISE LEVELS.

The instruments, rods and methods of moving the instruments and party were developed by this Bureau.

Lines of level in general follow railroad tracks, the rods are held when practicable on the head of the spikes which hold the rail to the crosstie.

The party, as well as the leveling instruments and outfit used are transported on motor cars, running on the rails. Rods are standardized at Washington before and after each field season.

Lines are broken by temporary Bench Marks into sections of from 1 to 2 kilometers.

At each city along the lines, at least two Bench Marks are established, and the rail elevation is taken at each railroad Sta. tion.

Forward and backward lines are run, under as different atmospheric conditions, as is possible, without unnecessarily delaying progress. When the difference between forward and back ward lines differ by more than 4 mm. x $\sqrt{k}$, k being the distance between Bench Mark in kilometers, both forward and back lines are run again. The methods consists in reading the three wires of the level diaphragm to nearest millimeter (estimated), the bubble being held continuously at the center of the tube (both ends being read). Read as soon as practicable the other rod; that is, if first reading is a Bench Mark, read the F. S. At each rod the temperature is observed from a thermometer attached to the rod.

At odd numbered Stations, Bench Marks are taken first and at even numbered Stations, F. S. are first taken. Differences in length of B & F Sights are not to be greater than 10 meters.

Errors of the level are determined once each day. The level is kept shaded, both while observations are being made, and when being moved between Stations. Maximum length of sights 150 meters.

Progress made is from 65 to 105 miles per month. Cost varies from $9.40 to $16.50 per miles. The average cost for 28 seasons, was $11.10 per mile, the office computation costs from 40 to 45 cents per kilometer, not including adjustment, etc.

DIVISION OF HYDROGRAPHY AND TOPOGRAPHY.

TOPOGRAPHY.

The Topographic and Hydrographic work of the Bureau is directed by the Chief of the Division of Hydrography and Topography. All Topographic Surveys are controlled by triangulation.

The triangulation Stations are plotted on plane table sheets, Scales, 1-10,000—1-20,000—in outlying regions 1-30,000.

The Shore line, and other details is then mapped in the field with the Plane Table, by reading stadia distances to salient points and plotting these distances and directions from established Plane Table Stations, while the Plane Table is in proper orientation.

The Shore line and detail, is then sketched or drawn through these points, in the field of operation. In June 1920 there were 3791 Topographic Sheets in the Archives of the Survey. The first Survey sheet was made in 1834.

HYDROGRAPHY.

In general the Hydrography is done by vessels and their attendant launches.

In sheltered waters, the Hydrographic Survey may be made by a shore party. While a shore party may operate at a materially less cost than a vessel party, owing to the necessity of having to use untrained recorders, leadmen and coxswains, it is but rarely that accurate and acceptable results may be obtained. There are at present 13 vessels, in commission, working on the Atlantic and Gulf, on the Pacific Coast and Alaska, and the Philippine Islands.

Owing to constant changes in depths in many localities resurveys at frequent intervals are necessary. Much of the offshore Hydrography has recently been and is now being supplemented to meet the needs of modern navigation.

In 1903, the Coast Survey began the development of the "long wire drag." This device passes a submerged wire set at a prescribed depth, over the area under investigation.

It consists of a wire, supported by buoys and floats so arranged that when towed by two or more launches the wire is submerged to a specified depth, and when passed over a given area establishes a depth that is free from all obstructions, however small in area.

The position of the "guiding launch," in wire drag work as well as the positions of the vessels, launches and boats while underway is determined at intervals, by sextant angles observed on three well determined objects on shore or in the water.

In the wire drag work the position of the end buoys attached to the submerged wire are determined from the guiding and end launches.

The depth set for the wire is corrected for stage of tide, and is shifted as the tide changes. In offshore work the soundings are carried offshore to a sufficient distance to determine certain curves, on the Atlantic and Gulf Coast generally the 100 fathom curve is developed, and on the Pacific the 1000 fathom located. Depths in offshore work are obtained by power sounding machines and sounding tubes.

In harbor and inshore work, angles are taken at intervals of from two to five minutes, and soundings are generally made at equal intervals of time, the notice to sound being given to the leadsman so that the lead reach the bottom at even intervals and at the time of the location of the boat by sextant angles. The positions, (sextant determinations of the position of the sounding boat)· are plotted with a three arm protractor within one minute after they are observed, this indicates if the boat is following the desired direction and speed. By means of a spacing divided (an instrument to divide a given space into equal parts) the soundings are spaced in accordance with the time intervals in proper position, between the sextant positions.

The custom now is to run lines closely spaced, in one direction crossed by lines in another direction, not so closely spaced. Where the soundings come near or over the same locality, on different sounding lines, the reduced soundings by their agreement in indicated depths, afford a check as to accuracy of results. Ends of Spits, shoal areas, and depths at critical points are determined by more closely spaced lines run in several directions.

In the wire drag work, when the wire encounters an obstruction the position is buoyed and the minimum depth developedd by the hand lead.

All sounding results are reduced for stage of tide and plotted in pencil on the smooth, (finished field sheet) by the field party while on the working ground so as to check the accuracy and proper development of all critical depths.

Lines of equal depth at 6, 12, 18, 24, and 30 feet and greater depths are drawn in pencil. The final inked soundings are the results of reduction for tide, etc., made at Washington Office, and the field penciled results are then checked and inked by the office force.

TIDES.

Automatic Tidal Stations are maintained at nine places on the Atlantic Coast, four places on the Pacific Coast, one in the Hawaiian Islands, and three in the Philippine Islands. Series of observations extending over many years have been observed.

These observations serve to determine mean sea level, the datum for precise leveling, and other engineering and scientific work.

These observations furnish data for the study of tidal phenomena, and the prediction of tides.

A machine was developed in the Coast Survey Office in 1882 and used from that time to 1910, when an improved machine was designed and built in the same office.

This machine enables predictions to be made for any period.

Generally twenty tidal components are used in predicting a Station, due to phase, declination, etc., of the sun and moon. The machine is designed to take into the predictions thirty-seven tidal components. No component is ordinarily used which affects the heights by 0.01 of a foot or less.

This predicting machine indicates the time and height of all high and low waters, for each day of the year. Also the height of the tide at any time. It draws a curve of the movement of the tides, from which may be scaled the height of the tide at any time. Predictions may be made for any number of years in the future or past.

The tides are predicted for eighty-one (81) principal ports of the world, the time and height of each high and low water being indicated. In the Tide Tables published by the U. S. Coast and Geodetic Survey, the times and heights of each high and low water, for the principal ports, is given, and difference in time and range, referred to the principal ports for 3.500 additional ports, are published, so that this information may be readily computed.

In addition to the General Tide Tables covering the world, there are issued Tide Tables for the Atlantic and the Pacific Coasts, as separate publications. Tide Tables are generally issued in June for the next following calendar year.

While Hydrographic Surveys are in progress, either an automatic Tide gauge is operated or a staff is observed at a main station supplemented by stations at which a staff is read during such hours, as sounding operations are in progress.

These supplemental stations are connected with the main station by simultaneous observations of 48 hours or more.

CURRENTS.

The prediction of currents is a more complex problem than that of the tides, but of great use, especially to navigators. Observations for strength and direction of current are taken by means of a current pole, log line and sextant angles or magnetic bearings, or current meters, of the bucket type, with a telephone. which permit the counting of the revolutions.

The tide tables show the predicted time of slack water for each day of the year at five localities on the Atlantic Coast and four localities on the Pacific Coast.

MAGNETICS.

The Magnetic work is directed by the chief of the Magnetic Division. Three magnetic elements are observed, declination, (the horizontal direction of the magnetic needle), inclination and horizontal intensity.

Since 1900, approximately 265 stations have been occupied each year. Certain stations are reoccupied from time to time, to determine the changes in the magnetic elements. All vessels of the survey make magnetic observations from time to time when en route to and from their field of work, and when directed. Permanent observatories are operated at which fluctuations are photographically recorded. Permanent stations are operated in Maryland, Arizona, Porto Rico, Alaska and in the Hawaiian Islands.

The Coast Survey has compiled available data for secular change for three centuries which is of great benefit to surveyors and others interested in the magnetic variation.

To determine the secular change, observations at intervals of five years are necessary, as the cycle of this change is of several centuries' duration. It is imperative that magnetic observations be made for an indefinite time. Five permanent magnetic observatories are operated, to which the results of the field parties are referred.

The results of the Bureau's magnetic work is of great interest to the scientific work, but its vital and immediate importance and use is to the navigator and surveyor.

RESULTS.

The technical publications and geographic positions, directions, description of stations, and description of bench marks, elevations, magnetic results, etc., are distributed free of charge. Such publications may be obtained from the Director, U. S. Coast and Geodetic Survey, Washington, D. C., upon request and presentation of proper credentials.

Photographs of original survey sheets, certified true copies of the originals may be obtained at the cost of reproduction. These sheets have been extensively used in legal proceedings.

The greater volume of the publications of the Bureau consist of nautical charts and books. The chart catalogue lists 657 charts, 12 volumes coast and inside route pilots (sailing directions), and 3 volumes of tide tables. Maps of the United States on convenient projections, to show least distortion, are published and sold at the cost of the paper and printing material. 300,000 copies of charts were printed during the fiscal year ending June 30th, 1920.

Nautical charts are issued primarily for the use of the navigator, those issued by this bureau cover the coast of the United States and the coasts under its jurisdiction.

On the Atlantic coast, four (4) series of charts are issued, consisting of sailing charts, small scale, and covering long stretches of the coast. General charts, three times as large as sailing charts, are used in coastwise navigation.

Coast charts are five times as large as the general charts, scale 1-80,000, which is approximately one nautical and 1¼ statute miles to one inch. These charts are for close coastwise navigation. The harbor charts on large scale, are for use in navigating in the various harbors and rivers.

As an example of the data and material used in construction of a chart, there were consulted and used for Chart No. 8102, 1000 volumes of original field records, 102 topographic sheets, 121 hydrographic sheets, 17 surveys by other organizations, 10 large scale Coast and Geodetic Survey charts, 5 foreign charts, 8 volumes of coast pilots, light and buoy lists, etc.

On Chart 369, New York harbor and approaches, the number of corrections applied annually is more than 6,000, consisting of changes in buoys, new wharves, changes in channels, depths, shoreline, etc.

In constructing a chart, a rough drawing is compiled by a cartographer and independently checked. This checked drawing is then traced and the tracing verified. The chart is then reproduced from this tracing. Charts are published from copper plate printing, or lithographic printing, 94% of the coast survey charts being printed on an offsetting lithographic press from aluminum lithographic or contact print plates. Aids to navigation, buoys, etc., are placed on the printed charts from to time so that they show the latest information. When these corrections become large in volume, a new edition of the chart in question is printed.

The New Orleans Field Station, 314 Customhouse, has complete file of all nautical and scientific publications of the Bureau, which may be consulted free of charge. I am in charge of this station and will be pleased to have members of the Society and the general public consult my files or call on me for information published or on file at the station or in the Washington office.

Geographic positions, azimuths and elevations, descriptions of stations and bench marks in the vicinity of New Orleans and much similar data for the Gulf states is on file at this station. Copies of such data will be supplied through the director at Washington.

THE CONTRACTING ENGINEER—A COG IN THE WHEEL OF INDUSTRY—HIS PROFESSIONAL RELATIONSHIP AND HIS DUTY TOWARD LABOR.

By John Riess.

About two or three hundred thousand years ago man was puttering away at his job as he is today. Primitive industry was carried on through family groups for the family group. However, ability soon manifested itself and it became expedient for certain individuals to travel from home to home and work up raw materials grown or produced by another. Of necessity he shared in the product of his labor. As yet there were no machines nor was there any grouping of workers. Quite early the man of ingenuity asserted himself and with the invention of machinery and the grouping of workers, industrial forces greater than the individual himself could be felt. Invention and study brought new civilization and created problems never guessed before and far from satisfactory solution today. The work specialist of the earlier days was the forefather of the present day engineer and the present day contractor.

The engineer, the man of ingenuity, is the man who by education and experience is capable of devising methods and machines tending to fit the necessities of industry and help carry forward a progressive world.

It was necessary in the early days of engineering science to establish a line of demarkation between the military engineer, the man who was devoting his attention to warfare (then a large part of the business of mankind) and the civil engineer who was employing his ingenuity in the arts of peace. Since, having been called upon to meet and cope with the demands of an ever widening and a more complex civilization, we have found it necessary for technical men to specialize still further, and we have branches and off-shoots from the parent tree in the shape of mechanical engineers, electrical engineers, mining engineers, etc.

A contract is a formal agreement and usually one that is legally binding. The contractor is a party to this bargain. Contracting is essentially a business. In a sense the contractor is a manufacturer in that he assembles materials to form a finished product. Experience and skill are necessary and so we find that the contract field needs and uses professional and technical men. The contracting engineer is a technical man specializing in the work of construction. He is a business man with large and liberal ideas and must associate himself with those who are doing big things.

It is right and proper for an engineer, after leaving strict professional work and engaging in contracting to dignify his calling by announcing in the name of his business the idea of his professional specialization. The contracting engineer is a professional specialist. Should we not look to him for all work and ideas looking toward the proper development and advancement in scientific construction? It is one thing to conceive and draft something radical and it is another thing to solve the problem of its execution and one equally as important. The design of the tallest building or of the greatest bridge span is not a bit more important than the power and ability to overcome the seeming insurmountable obstacles incident to the execution of the work as designed. Decisions as to method mean more to the contractor than to the designing engineer because a profit usually weighs in the balance and real money has to be spent.

The question of ethics, or the propriety of the engineering contractor in entering the field of design and of accepting fees or retainers for his professional work as a consultant naturally arises. This question is really more alive in the case of the sales engineer than it is with the construction man. It is rather unusual (and may we say unfair?) for an engineer in the construction field to bid in competition with others on plans which he himself has prepared. When all is said life is a struggle and we could not say definitely to the sales engineer nor to the contracting engineer that you cannot undertake a specified piece of work because you would be depriving a brother engineer of a profit when this same sales engineer is struggling to make a living for himself. Square deal and fair play ideas when worked with fine analysis will usually determine whether or not it is ethical for an engineer to undertake work more professional than business in character.

The existence of the contracting engineer as a business factor furnishes a good index of his necessity and sufficient reason can be found which makes it desirable for the technically trained engineer to enter the contract field. Something will now be said of his duty toward labor.

It is in the consideration of the problem of labor that the contracting engineer should differ from the engineer and from the contractor. The engineer must concern himself with the economic use of material. The contracting engineer must also concern himself with the economic use of an especial kind of material—human material. It is to him that the world should look for a satisfactory solution of the age long conflict between capital and labor. He should make scientific use of this material and adopt it to the needs of mankind.

The commodity theory of labor, wherein man is likened to and regarded as a machine is widely held. Labor is quite hostile to this idea. During past years there has been an undoubted tendency to exploit labor and among certain employers a great effort made to crush any manifestation of the independence of labor. Naturally there has been conflict. This manifests itself in the never-ending fight between the employer and the employee; the fight between capital and labor. Any group of men feeling the need for protection or privilege or the necessity for fight against oppression, real or fancied, will organize. We note the large business combinations and the success achieved. The trade union movement, as represented here by the American Federation of Labor, demonstrating its success along certain lines in the betterment of the condition of the working man has spread and is now to be considered as the most wonderful organization in the world, rivaling in strength along certain lines our national government.

From the very beginning of civilization we have had class distinction. The lines may be so sharply drawn as to make it impossible for an individual to advance from one class to the next higher. Again, these lines may be drawn only in faint tracing so that a man can make for himself a place in any class, all depending on his own ability and initiative. The history of industrial progress parallels that of social unrest, with trade organizations or unions as an index. From colonial times we have had our labor problems and our class distinctions and the politicians of that time wrote into the Constitution of the United

States the much quoted sentence: "We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain inalienable rights, that among these are life, liberty, and the pursuit of happiness."

The labor movement has reached its highest development in the American Federation of Labor. This organization is complete and assumes to speak for all branches of labor. It is the enemy of capital (the name for the employing class) although not so avowed. It has a wonderful leader in the person of Mr. Samuel Gompers, for thirty-eight years president of the Federation. We find it hard to state just what are the demands and and the aspirations of the average trade union. If we carry the organization idea out to the ultimate goal as seems to be their aim, we accentuate class distinctions instead of doing away with these evils. We will take away from the average man any incentive to better his position in life and make for mediocrity. Wage scales as usually adopted, while said to be minimum are in reality maximum. As a matter of practice inefficiency predominates and there is a decided lowering of output and quality of work upon complete unionization. Labor is continually fighting for wage increases, always alleging that the wages as paid are insufficient to assure a decent standard of living. This standard is apparently an ever-changing one. Labor forgets that this is a world of workers and that the small minority represented by the trade unions is guilty of as much abuse as is the capitalist who is in hopeless minority. It has been aptly said that only the "squeaking wheel gets the grease." Laborites, even though in the minority, get as much and probably more than should come to them. The average citizen sits quietly back and accepts conditions as he finds them and can be easily lead.

Labor unrest manifests itself in strikes, lack of production, and labor turnover. In the year 1919, strikes and lockouts cost the United States 143,850,000 days of production. The direct loss of wages was more than a billion dollars. A single plant employing a thousand workers could only offset this enormous loss in about 450 years. "Ca Canny" is the term now quite generally used to describe a conscious slowing down of effort on the part of labor. It is attempted to create an artificial shortage thus forcing employers to bid against each other for labor; or to make places for other laboring men by requiring the use of more help or additional machines to hold to a definite output. The system is ugly and immoral. Labor shortage and labor turnover usually go hand in hand. The higher the wages paid the greater the labor turnover.

Two definite causes tend toward social unrest, exploitation and parasitism. Unquestionably the number of parasitical occupations has multiplied and too many men are now engaged in unproductive or "genteel" occupations. Again, you will find the ruthless employer who would exploit labor no matter what the consequence. Labor is resentful of being treated as a commodity and protests against regulation by supply and demand. Further, labor is sullen and we no longer find the old-fashioned loyalty. They all feel that they are worth more than they are getting and do as little as they dare for a day's pay and actually revel in the idea that the employer is making a loss because of his effort.

The trade union may be considered necessary and frequently results in great benefit in the righting of minor evils which beset certain branches of industry. The strike weapon as used is vicious and seldom accomplishes anything good or permanent. One of the great disasters of trade unionism is politics and the ambition of members to hold political jobs. It is a fact that as soon as an ardent trade unionist gets a political job he loses much of the enthusiasm formerly displayed. He comes in contact with new associates and influences and this in a large measure accounts for his change. It would seem that we could liken the trade union movement as at present conducted to a country wag sitting on a soap box and whittling away at a finely grained piece of wood. In this idle work he fashions articles which are lost before taking permanent form. The stick is finally used up and we have left only shavings—and have lost a good piece of wood. The spokesman for the trade union preaches only the loyalty of labor toward labor and decries any principle or idea of the loyalty of labor to an employer or of co-operation with him. If we omit socialistic theories, admittedly impractical and utopian, labor puts forwards few if any constructive ideas looking toward the general betterment of its position.

My theory of the solution of the labor problems that we have with us is essentially in the hands of our state and national governments. Individuals, because of the necessity of battling for a living are selfish and only when led and shown the necessity will make personal sacrifice for the general good. What policy should a nation adopt to link capital and labor so as to reduce industrial warfare and raise the level of efficiency? Paternalism on the part of the individual or company employer in the handling of labor is usually resented by a large number. Welfare work is necessary and of unquestioned good when conducted properly. As an example we could cite the United States Steel Corporation under the able leadership of Judge Gary. Here is a corporation with assets of $2,250,000,000.00 and having 250,000 employees. The steel corporation has always refused to recognize the right of the trade union to have any voice in the management or in the shaping of its policies. Nevertheless, this same steel corporation, feeling that it knew better what was good for the workingman than he himself knew, has been spending about $15,000,000 per annum for welfare work. Should the strike evil continue to exist with the consequent choking of industry? While we must look to the state and the nation for solution we must not have pernicious class legislation. As an instance we take the Clayton Act of 1914 which specifically declares that labor organizations shall not be considered as illegal combinations. Several of these organizations have the power to completely paralyse industry and are productive of more harm than the greatest trust in existence today. The government in turn through the tax medium could prevent the acquisition of immense fortunes and do away with the non-productive man. "Human welfare should be the keynote of the political economy of any period." Human welfare, as I take it means a satisfied body politic, and by this it is understood that the masses are content. Contentment is what we struggle for. The happy man is the contented man no matter what may be his station in life.

The contracting engineer as an employer of labor should be a specialist in its management. He should be a student of the problems which beset labor and have a voice in constructive legislation looking to the betterment of the position of the laboring man. Radical leaders have unfortunately been in control of the labor situation and they have done very little more than decry the ownership of property and are stifling the ambitions of the able men in the world today. Abraham Lincoln has said: "Property is the fruit of labor; property is desirable, is a positive good in the world. Let not him who is houseless pull down the house of another, but let him work diligently and build one for himself, thus, by example, assuring that his own will be safe from violence when built." As stated above we must look to legislation for constructive measures looking to the advancement of the position of the laboring man. While we dislike to admit it, the highly centralized and paternal form of government is probably best for the masses.

Intermittent employment or enforced idleness brings discontent. It is clearly the duty of a state to look after its unemployed. The man who is willing to work and who is suffering because of his inability to find employment must invite sympathy and should be taken care of by the body politic. This idleness under our present system may strike any industry at any time. We must only look to the happenings of the past six months to see how nicely balanced is supply and demand. A little slowing down in consumption and a little in the way of overproduction of basic food articles and commodities have produced abnormal business. The government should act as a balance and safety to stabilize conditions.

From the above it will be seen that the contracting engineer has a real problem in dealing with human material and with human machines. As stated the problem is essentially one of government. It is right and proper that the thinking employers lead in the shaping of governmental policies. Does the average man known that out of every dollar paid into the national treasury ninety-three cents goes to pay for past and future wars, for the war debt, pensions, the army and navy? One cent of each dollar goes for the departments of government dealing with human welfare, education, agriculture, public health, and scientific research. The remaining five cents is spent on the machinery of the government. Soldiers and sailors belong to the non-productive class. Our present policies by adding hundreds of thousands to this class makes more acute the restlessness of the workers. Would it not be far better if the ninety-three cents of the tax money collected were spent on the construction of decent houses, on highways, on harbor improvements and buildings? What is the average government doing to add to the contentment of the masses and toward the uplift of civilization?

We have efficiency engineers and engineers specializing in management and both do good work and are probably necessary because the average employer becomes blind to his own faults. But these men as a rule are theorists and have no intimate knowledge of real working conditions. The contracting engineer is a trained employer and should help materially in the solution of our present day problems.

HURRICANE ENGINEERING.

A Discussion of Dr. Isaac M. Cline's Paper Entitled "Storm Tides on the Gulf Coast."

By CHARLES EVAN FOWLER, M. Am. Soc. C. E., Consulting Engineer.

The scientific data in regard to Hurricanes on the Gulf of Mexico has received a very valuable addition in Dr. Isaac M. Cline's paper, entitled "Storm Tides on the Gulf Coast," and published in the October Proceedings of the Louisiana Engineering Society. The study of this paper discloses the need of a much more extended basis for observations, especially with regard to those features of value to those engineers and constructors engaged in planning new storm-proof structures.

This special need may be taken as the basis for Hurricane Engineering, and to call for better data as to the velocity and force of the winds; the velocity of the moving water in waves, together with their height and force; the height and characteristics of the storm tides; and the speed and force of the combined currents, which are compounded mainly from the velocity imparted directly by the wind, and the waves of translation, combining with ordinary tidal currents, and storm tide currents.

The means for obtaining this data would be the organization and usual instruments of the Weather Bureau, supplemented by such other instruments as may be added to this ordinary equipment, located at the present stations and at a comparatively large number of new and carefully located auxilliary stations. There is moreover a necessity for a much firmer method of fastening the instruments, so that records will not be incomplete through their being blown or washed away. The instruments must be self-recording, so far as possible, on account of the danger to observers remaining at outside posts, especially when islocated.

The nomenclature of hurricane data must to some extent be revised and enlarged, and it can be made to conform closely to that adopted by Prof. Douglas Wilson Johnson, of the Department of Physiography of Columbia University, in his very remarkable book, "Shore Processes and Shore Line Development," which should be read and studied by all those interested in the action of winds, waves and currents. The term Storm Tides as given by Dr. Cline will be a valuable addition to the nomenclature. The first five chapters of this book are of particular value to the engineer, disclosing much that is new and exposing many mistaken theories and not a few fallacies. The very exhaustive references to the many books and authorities, results in placing the subjects discussed upon a much firmer basis than has before seemed possible to the student of this class of natural phenomena.

The attempt to study the records of winds, brings one at once face to face with an almost entire lack of exactness or uniformity in the recording of data. Whether the velocity given is a recorded value or an actual velocity is seldom stated, and not infrequently estimated values are recorded in such a way as to lead one to believe that they are recorded in such a way as to lead that really interests the engineer is not altogether the velocity of winds, but the resultant pressures; and due to the fact, that the studies made by Smeaton were the first extensive ones, his conclusions have long been accepted, and his formula for pressure as a function of velocity adopted as abundantly safe or practically correct by very many engineering writers. This formula,

$$p=0.005\ V^2$$

is the one adopted by the writer in "Sub Aqueous Foundations," and has been retained in his new treatise "Engineering and Building Foundations," because it gives a reasonable margin for safety; this covering possible incidental effects that would not be provided for in the supposedly exact Weather Bureau formula,

$$p=0.004\,\frac{B}{30}\,V^2$$

in which B is the barometric reading in inches at the time the velocity was recorded, and to be anywhere near correct an exact correlation must be had for the barometric and annemometric readings. The need for this is clearly stated in Dr. Cline's paper, but of greater value still would be direct pressure readings made on pressure boards somewhat similar to those used for the Forth Bridge experiments in Scotland, where pressures as high as 56 pounds per square foot were recorded. This was the value used in designing the Forth Bridge and also the Tay Bridge. Such pressure boards should be placed alongside the annemometer at each station and simultaneous readings secured.

The highest wind velocities recorded in any of the Gulf hurricanes from 1900 to 1920 was the somewhat steady blow on Sept. 29th, 1915, of 128 miles per hour, and the velocity of 140 miles per hour for one mile on the same date. This corresponds to 82 pounds per square foot, and 98 pounds per square foot respectively by the use of the Smeaton formula! Using the more exact formula, which for the lowest 1915 barometer reading of 28.15 inches becomes

$$p=0.0375\ V^2$$

we find 62 pounds per square foot, and 74 pounds per square foot, respectively. The pressure from the 140 mile gust may be partially disregarded by the engineer in his detailed design, but must have a distinct bearing in his selection of the general design for a structure. The pressure from a steady blow of 128 miles must, however, be taken into account in detailed design, and indicates that the 56 pound pressure used in English designs and which have been lightly considered by American engineers for all conditions are not high enough for use in designing structures for the territory bordering on the Gulf of Mexico. The highest velocities and pressures of the Gulf Hurricanes since 1900 may be tabulated as follows:

				Pressure.	
Year.	Date.	Max. Velocity.	Location.	Smeaton.	U.S.W.Bur.
1900	Sept. 8	120	Galveston	77	55
1901	July	Nom.	Galveston	Nom.	Nom.
1901	Aug.	65	Port Eads	21	17
1906	Sept.	40	New Orleans	8	6
1909	Sept.	60	Mobile	Nom.	Nom.
1910	Oct.	Nom.	Port Eads	18	14
1915	Aug.	90	Florida	Nom.	Nom.
1915	Sept. 2	25	Galveston	41	31
1915	Sept. 29	140	Burwood	98	74
1916	July	100	Mobile	50	40
1916	Aug.	40	Galveston	8	6
1917	Sept.	97	Pensacola	47	36
1918	Aug.	Nom.	Lake Charles	Nom.	Nom.
1919	Sept.	80	Corpus Christi	32	24
1920	Sept.	60	Near Morgan City	18	14

The writer has charted all of these hurricanes on one sheet, and a study of this, and a similar chart of older hurricanes made by Fassig indicates that no section of the Gulf is immune from hurricanes, nor from one of maximum intensity. Those studied by Fassig were 134 in number, extending over the 35 years from 1876 to 1910. They extend from May to November, although 25 per cent of them occurred in August, 32 per cent in September, and 31 per cent in October. The maximum number in any one year was 11 in 1886, and the same number in 1887. Thus they may be considered as confined to the period of late summer and fall. The hurricane usually recurves, following a parabolic path, and has an average daily movement or advance in the first branch of 260 miles per day, with an average of 392 miles per day in the second branch. The destructiveness may be said to be less from the wind than from the storm tides, waves, and current, as was observed at Corpus Christi in 1919, and elsewhere in various hurricanes. This is due somewhat to the fact that structures can and have been built to withstand heavy wind pressures, but there is great need for the designing of structures of all kinds, of a general type and so detailed as to nullify so far as possible the wind effect, and it may be said with confidence, from recent studies made by the writer, that this can be done with comparative ease and sureness.

The force of the waves may be nullified to a large extent by many of the details that are of useful effect as against winds, but when the character and force of waves is fully appreciated, it is at once seen that engineering designs and details must be of a somewhat revolutionary character. Practically all engineering or scientific writers discuss fully oscillatory waves and their action, but either do not know or fail to appreciate that it is "Waves of Translation" that are of real force and destructiveness. The water must be moving forward with great velocity to strike the terrific blows that often hammer the strongest existing structures to pieces, unless they have been made of special design to minimize the force. The reader of Vernon Harcourt, the great English engineering authority, finds in his various writings on harbors, that he makes no mention of Waves of Translation, and Gaillard, in his well known monograph on "Wave Action," fails to appreciate the vital difference between the two types of waves. The real discoverer of the Waves of Translation was the English writer, J. Scott Russell, and they are discussed in his reports on Waves made to the British Association for the Advancement of Science at their meetings in 1836, 1837, 1843 and 1844. They are not of vital importance in the ocean, where they are formed to some extent, but Oscillatory Waves are transformed as they near the coasts, and in shallow water into Waves of Translation or a form with real destructive action, and not conformable to the laws of waves as usually given for those of the oscillatory type; because while the water particles of Waves of Translation move forward, they have no backward movement. The first writer to discuss this extensively is Johnson, in "Shore Processes," and the reader is advised to study his pages, and discover that nearly all one has learned of waves concerns the engineer, was founded upon an erroneous hypothesis.

The destruction at Corpus Christi in 1919 taught them that the century old belief that the hurricane waves spent their force on Mustang Island and the other low islands about 15 miles out, was erroneous; and that with a Storm Tide of nearly 13 feet, carrying Waves of Translation on its crest, even for the short fetch of 15 or 16 miles across the very shallow bay, the waves reached a height of from 10 feet to 12 feet! Such waves may strike a maximum blow of 3000 lbs. per square foot. Their great velocity and destructiveness has caused writers to describe their combined action as a Tidal Wave! The writer doubts if a true or real tidal wave has ever occurred during any of the Gulf hurricanes. The fact can be positively stated that such low barrier islands and shallow waters as occur off Corpus Christi and other Gulf localities are not a protection that can be depended upon.

The waves off the open shore at Peterhead, in North Britain, are also evidently transformed into Waves of Translation, as on February 15 and 16, 1900, with a wind of from 50 to 89 miles per hour and in water only from 60 to 65 feet deep, the waves rose to a height of 22.5 ft. above still water level, or a total wave height of over 30 feet, possibly over 40 feet.

The writer, on December 14th, 1920, was crosing the Detroit River by ferry at 10 o'clock a. m. and found a very high wind blowing directly up the river at the time, and very high waves running in about 40 feet of water and with a fetch of only between 2 and 3 miles. The velocity of the wind, by a visit to the Weather Bureau afterwards, was found to be 54 miles per hour, and waves were observed on the sides of a scow being towed in midstream, of from 6 feet in height to over 7 feet. Upon my return at 12:00 noon the wind velocity had increased to 60 miles per hour, and waves were observed from 7 feet to 8 feet high, which height was verified by an engineer associate along with me. It is interesting to note that the writer, weighing 200 pounds, could just walk against the 60 mile wind, and that he saw a lady blown off her feet.

The account by Dr. Cline of the September 29, 1915, hurricane speaks of swells of from 10 to 12 feet running on the Mississippi River. Russell records that he never saw waves 10 feet high in 10 feet of water, nor 20 feet high in 20 feet of water, although he has seen waves approach very nearly to those limits.

The observations of many observers as recorded by Johnson lead him to say that when waves run into shallow water they seem to awaken into new life, crowding closer together and increasing in height until they break; likewise waves running against a current increase in height. Such Waves of Translation transmit forward their full energy, while only one-half the energy is so transmitted by Oscillatory Waves.

The highest recorded Storm Tide on the Gulf coast was of 16 ft. in 1919, near Corpus Christi; one of 9.8 feet in Lake Borgne, near the Rigolets, or the entrance to Lake Pontchartrain, and one of 13 feet near Frenier, at the western end of Pontchartrain. The amount of water that passed in and out of Pontchartrain, must have amounted to nearly 90 billion cubic feet! The great maximum velocity of this is evidenced by the way in which it tears out great areas of the marshes. The height to which structures must be raised to clear such maximum Storm Tides as 16 feet, carrying wave crests 9 feet above such level, is thus clearly shown, and if such a clearance is impossible, then, as stated, the design of structures must be such as to largely nullify the wave force.

The currents during a hurricane have, so far as known to the writer, never been measured, but it is fair to assume that at least the surface current as partly generated by the wind and

Waves of Translation, when added to the usual currents, will have an exceedingly high velocity. While the ordinary tidal currents in channels at various points along the Gulf coast may have only a maximum value of from 4 to 8 miles per hour near the surface, it is quite certain that the combined surface velocity may reach as high as 12 to 15 miles per hour during a wind of a velocity exceeding 100 miles per hour. The serious disturbance from waves reach to depths of water of 60 feet or greater, and the combined current as above will have a velocity at similar depths that will cause serious scouring effects in channels having ordinary materials for the stream bed. Thus by observations as to the class of material scoured out, we can easily fix the velocity at the bottom of any channel, and it will, in the writer's opinion, seldom be found less than 4 miles per hour in ordinary channels from 50 to 60 feet deep. This would cause scouring in sand and even fairly heavy gravel. The reduction of current velocity from near the surface to the bottom of a river has roughly the curve of a convex ellipse, but the reduction of velocity from the surface to the bottom, in a tidal channel during a hurricane, would undoubtedly approach nearly to the curve of a concave parabola, due to the banking up of the swiftly moving water against the slower moving or comparaticely slack water of the ordinary flow. While this is only a common sense viewpoint or solution of the problem, it is to be hoped that some organization can undertake such measurements as will surely determine the conditions of flow in tidal channels during a hurricane or at least during very high winds, and also determine the currents off shore. The observations should be accompanied by other observations and records of the destruction caused by the currents impinging upon various structures, as distinguished from waves action, insofar as that may be possible. However, if the exact velocity of the currents can be determined, together with their variation over the cross section of the channel, then the usual formulas may be safely used for determining the force exerted.

The great and commendable work of the officials of the Weather Bureau in sending out hurricane warnings to vessels, and to various localities on land, has resulted in the saving of thousands of lives, and doubtless of very many ships and vessels, but they are practically impotent when it comes to saving buildings and structures on the shore or inland to where the winds, waves and currents reach. The suggested gathering of data will, however, result in enabling the engineer, architect and constructor to so design and build future structures, that they will pass unscathed through the most violent storms, and without any unnecessary expenditure to accomplish such a desired end. The writer is equally confident that the careful and intelligent study of such data and information as is now available would result in very greatly improved conditions, and a very great conserving of the capital to be invested in the future.

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JAMES W. BILLINGSLEY, (1914), Consulting Engineer, Interstate Bank Bldg., New Orleans.

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W. P. BRANDIN, (1907), Draftsman, Public Belt Railroad, 1726 Elysian Fields Ave., New Orleans.

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R. T. BURWELL, (1908), Manager, Gulf Department, Hartford Steam Boiler Inspection and Insurance Co., 308 Canal Bank Bldg., New Orleans.

ASHLEY CALONGNE, (1914), Assistant Engineer, with S. A. Calongne's Sons, 630 Gravier St., New Orleans.

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J. F. COLEMAN, (C. M.), of J. F. Coleman Engineering Co., 822 Perdido St., New Orleans.

J. A. COMMAGERE, JR., (1915), Inspector, U. S. Engineers, 1800 Bayou Road, New Orleans.

W. H. P. CREIGHTON, (1912), Professor of Mechanical and Sugar Engineering, Tulane University; Tulane University, New Orleans.

HORACE E. CRUMP, (1912), Office Engineer, Board of Commissioners, Port of New Orleans, No. 1 Canal St., New Orleans.

DAVID L. CULLOM, (1916), Assistant Engineer, Board of Commissioners of the Port of New Orleans. 3629 Baronne St., New Orleans.

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B. N. DAVIS, (1913), Engineer and Contractor, 504 Poydras St., New Orleans.

EUGENE F. DELERY, (1915), Assistant Engineer, Sewerage and Water Board, 1129 Jena St., New Orleans.

ELLIOTT J. DENT, (1919), Lt. Col. Corps of Engineers, U. S. Army, 329 Custom House, New Orleans.

DONALD DERICKSON, (1912), Professor of Civil Engineering Tulane University, New Orleans.

JACQUES de TARNOWSKY, (1915), Structural Engineer, 602 Canal Bank Annex, New Orleans.

J. L. DICKEY, (1915), Contracting Engineer, 8004 Hickory St., New Orleans.

M. P. DOULLUT, (1911), President Doullut & Williams, Inc., Civil Engineers and General Contractors; President Southern Lighterage and Wrecking Co., Inc.; President Shell Road Land and Improvement Co., Inc.; President Louisiana Navigation and Fisheries Co., Ltd.; President Doullut & Williams Shipbuilding Co., Inc.; Office, 1012 Whitney Bldg., New Orleans.

ALLAN T. DUSENBURY, (1909), Drainage and Reclamation Engineer, 201 Marine Bank Building, New Orleans.

GEORGE E. EARL, (1900), General Superintendent, Sewerage and Water Board of New Orleans, Room 402, Sewerage and Water Board Bldg., New Orleans.

RALPH EARL, (1913), Assistant Director of Water Purification Department, 2142 Eagle St., New Orleans.

JOHN THOMPSON EASTWOOD, (1901), Principal Assistant Engineer, Sewerage and Water, Sewerage and Water Bldg., New Orleans.

MARION J. EPLEY, (1920), 6023 Hurst St., New Orleans.

JAMES P. EWIN, (1915), Chief Engineer, Doullut & Williams Shipbuilding Co., Inc., New Orleans.

ROBERT FAGET, (1919), 523 S. Pierce St., New Orleans.

CHARLES A. FAVROT, (1919), 18 Richmond Place, New Orleans.

MARSHALL G. FINDLEY, (1919), 3517 Palmyra St., New Orleans.

EDWIN J. FISHER, (1913), Electrical Engineer and Contractor, 520 Gravier St., New Orleans.

A. M. FROMHERZ, (1915), Associated with Jos. Fromherz, General Contractor, 302 Titlle Guarantee Bldg., New Orleans.

FRANK G. FROST, (1919), New Orleans Railway & Light Co., New Orleans.

MARCEL GARSAUD, (1905), Engineer and Contractor, 515 Whitney Bldg., New Orleans.

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W. B. GREGORY, (1907), Professor of Experimental Engineering, Tulane University, and Irrigation Engineer, U. S. Department of Agriculture, Tulane University.

B. H. GREHAN, (1914), 1736 Second St., New Orleans.

A. H. GUILLOT, (1917), Assistant Engineer, N. O. Railway and Light Ca., 201 Baronne St., New Orleans.

ADAM J. HAASER, (1916), Purchasing Agent and Mechanical Engineer, Vaccaro Bros. Co., 517 Olivier St., New Orleans.

FARRAR PETRIE HAMILTON, (1915), Vice-President, Creosoted Materials Co., Inc., 301 Q. & C. Bldg., New Orleans.

GEORGE R. HAMMETT, (1920), 2015 Calhoun St., New Orleans.

CHARLES J. HARDY, (1909), Civil Engineer, 1306 Peters Ave., New Orleans.

M. V. HAULARD, (1906), Superintendent of Track, New Orleans Railway & Light Co., 4154 Iberville St., New Orleans.

LEWIS G. HEIDER, 1920), 411 Canal Bank Bldg., New Orleans.

W. S. HENNING, (1919), 2025 Robert St., New Orleans.

WALTER H. HOFFMAN, (C. M.), Civil Engineer, care Chess, Checkers and Whist Club, New Orleans.

W. T. HOGG, (1913), Chief Draftsman, Board of Commissioners, Port of New Orleans, 841 Exposition Blvd., New Orleans.

FRANK HOLT, (1915), Engineering Department, New Orleans Park Commission, 2730 Myrtle St., New Orleans.

E. M. HORNOT, (1912), Chief Engineer, Gulf and Valley Cotton Oil Co., Gretna., La.; 2011 Prytania St., New Orleans.

NORMAN A. HOTARD, (1913), Assistant City Engineer, 235 Lavergne St., New Orleans.

FERDINAND G. HUMMEL, 1919), 3307 Prytania St., New Orleans.

ANDREW W. JACKMAN, (1913), 1704 Calhoun St., New Orleans.

HARRY JACOBS, (1919), Civil Engineer, 834 Ida St., New Orleans.

ERNEST LEE JAHNCKE, (1900), President, Jahncke Dry Dock and Ship Repair Corporation, New Orleans.

PAUL F. JAHNCKE, (1908), Vice-President, Jahncke Dry Dock and Ship Repair Co., Inc., 814 Howard Ave., New Orleans.

WARREN JOHNSON, (1903), Consulting Engineer, The Johnson Iron Works, Ltd., New Orleans.

THOMAS P. JOHNSTON, (1920), 1914 Milan St., New Orleans.

CHARLES E. JOUBERT, (1909), Civil Engineer, 838 Broadway, New Orleans.

ERROL E. KELLY, (1920), 1200 Port St., New Orleans.

JAMES P. KEMPER, (1909), Civil Engineer in Private Practice, 310 Audubon St., New Orleans.

CHARLES MacDONALD KERR, (1914), Engineer, Creosoted Materials Co., Inc., 301 Queen & Crescent Bldg., New Orleans.

FRANK M. KERR, (C. M.), Chief State Engineer of Louisiana, 213 N. O. Court Bldg., New Orleans.

FREDERICK D. KING, (1916), 1418 Seventh St., New Orleans.

CHARLES KIRSCHNER, (1917), Assistant Field Engineer, Board of Commissioners of Port of New Orleans; 1327 Esplanade Ave., New Orleans.

JOHN KLORER, (1898), City Engineer, City Hall, New Orleans.

HERMAN KOKOSKY, (1903), Member of firm of Kokosky & Co., 614 Gravier St., New Orleans.

EDWARD S. LANPHIER, (1918), Superintendent of Lighthouses, Room 224, Customhouse Bldg., New Orleans.

FERD. L. LARUE, (1919), 823 Esplanade Ave., New Orleans.

G. W. LAWES, (1898), Secretary Board of State Engineers, 213 N. O. Court Bldg., New Orleans.

ALBERT J. LEGETT, JR., (1919), Assistant Manager, Johnson Iron Works, Dry Dock and Shipbuilding Co., Inc., 1431 Frenchmen St., New Orleans.

J. H. LEWIS., (1908), Captain of Engineers, U. S. R.; Home Address, 1201 Q. & C. Bldg., New Orleans.

A. M. LOCKETT, (1900), President A. M. Lockett & Co., Ltd., 533 Baronne St. New Orleans.

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H. G. MARTIN, (1920), 1322 Dublin St., New Orleans.

A. S. MONTZ, (1919), Consulting Engineer (Structural), 707 Title Guarantee Bldg., New Orleans.

IRVING H. MORSE, (1919), 2812 State St., New Orleans.

WALTER B. MOSES, (1912), Mechanical and Electrical Engineer; Vice-President Engineering Sales Co., Inc., 640 S. Peters St., New Orleans.

JOHN HENRY MURPHY, (1914), 1322 Felicity St., New Orleans.

FRANK A. MUTH, (1915), First Assistant Superintendent, Lighthouse Service, 2323 Short St., New Orleans.

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BERNARD STANLEY NELSON, (1911), Chief Engineer, A. M. Lockett & Co., Ltd., 521 Baronne St., New Orleans.

WILLIAM T. NEWTON, (1915), with L. F. Alexander & Co., 5923 Coliseum St., New Orleans.

WILLIAM F. OAKES, (1918), 707 Title Guarantee Bldg., New Orleans.

JOHN A. O'BRIEN, (1920), Engineer and Contractor, 716 Calhoun St., New Orleans.

ROBERT M. O'BRIEN, (1916), Superintendent of Equipment, N. . Ry & Light Co., 5315 Camp St., New rleans.

OLE K. OLSEN, (1905), Contracting Engineer, 822 Perdido St., New Orleans.

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

J. DEVEREUX O'REILLY, (1912), Engineer, Board of Commissioners of the Port of New Orleans, Liverpool & London & Globe Bldg., New Orleans.

H. A. PALLFELT, (1914), Civil Engineer, Standard Oil Co. of La., 1206 Whitney-Central Bldg., New Orleans.

HYMAN RABINOVITZ, (1911), with A. M. Lockett & Co., Ltd., 521 Baronne St., New Orleans.

LESTER H. RAYNER, (1920), 2116 Canal St., New Orleans.

LYMAN C. REED, (1907), Vice-President-Treasurer, Southern Jobbers' Supply Co., Inc., 534 Bienville St., New Orleans.

HAMPTON REYNOLDS, (1910), General Contractor, 1304 Carrollton Ave., New Orleans.

JOHN RIESS, (1906), Engineer and Contractor, 503 Hibernia Bldg., New Orleans.

OSCAR RIESS, (1916), Engineer, with John Riess, Engineer and Contractor, 1423 Milan St., New Orleans.

JAMES M. ROBERT, (1908), Professor of Mechanical Engineering, Tulane University; in charge U. S. Shipping Board Marine Engineer School, Tulane University; Director, Night Classes in Engineering, Tulane University, New Orleans.

EDWIN J. H. RODDIQUEZ, (1918), Zymothechnic Chemist, 143 Park Row, New Orleans.

R. P. RORDAM, (1912), Civil Engineer, 6322 South Liberty St., New Orleans.

GEORGE C. SCHOENBERGER, (1919), Assistant State Engineer, 213 New Orleans Court Bldg., New Orleans.

ARTHUR M. SCOTT, (1915), Engineer, with Ole K. Olsen, Concrete Engineer, 822 Perdido St., New Orleans.

J. H. SEAMAN, (1912), Distributor Huffman Trucks and Cars, 4501 S. Johnson St., New Orleans.

GEORGE ARTHUR SEAVER, (1920), 2011 Marengo St., New Orleans.

SOLIS SEIFERTH, (1911), 1538 Seventh St., New Orleans.

A. M. SHAW, (1910), Consulting Engineer, 617 Common St., New Orleans.

LESTER C. SMITH, (1920), 1012 Whitney Bldg., New Orleans.

CHARLES E. SNYPP, (1911), Engineer, with Southern Cotton Oil Co., Gretna, La.

DAVID WHYTE STEWART, (1920), 2329 General Pershing St., New Orleans.

EDGAR L. STREAM, (1915), Chief of Engineers, Vaccaro Bros., care Vacarro Bros. & Co., Q. & C. Bldg., New Orleans.

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

EUGENE UNSWORTH, (1919), Assistant Chief Inspector, New Orleans Department Hartford Steam Boiler Insp. & Ins. Co., 308 Canal Bank Bldg., New Orleans.

GILBERT D. VON PHUL, (1916), Contracting Mechanical Engineer, 322 Hibernia Bldg., New Orleans.

FRANK H. WADDILL, (1898), Consulting Civil Engineer, 407 Canal Bank Annex, New Orleans.

GEORGE D. WADDILL, (1911), Assistant Engineer, U. S. Eng. Office, 5219 Camp St., New Orleans.

J. D. WALKER, (1908), Kelly-Walker & Kaufman, Engineering Contractors, 504 Marine Bank Bldg., New Orleans.

ALFRED L. WEBRE, (1913), care E. B. Badger & Sons, 75 Pitt St., Boston. Mass.

LEO S. WEIL, (1920), 2 Dunleith Court, New Orleans.

LEON C. WEISS, (1918), 611 Maison Blanche Bldg., New Orleans.

THOMAS M. WHITE, (1912), Manager of Winnfield Plant, American Creocote Works, Winnfield, La.

BEN WILLARD, (1900), Local Manager, General Electric Co., 901 Maison Blanche Bldg.; 4001 Vincent St., New Orleans.

W. HORACE WILLIAMS, (1908), Member American Society C. E.; Sec'y-Treas. and General Manager, Doullut & Williams Shipbuilding Co., Inc.; Sec'y-Treas. and Managing Engineer, Doulut & Williams, Inc., Civil Engineers and General Contractors; Sec'y-Treas. and General Manager, Southern Lighterage & Wrecking Co., Ins.; Sec'y-Treas. and General Manager, Shell Beach Land & Improvement Co., Inc., New Orleans.

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

VICTOR L. WILLOZ, (1900), Superintendent of Distribution, N. O. Ry. & Lt. Co., 201 Baronne St., New Orleans.

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

ALLAN L. WOLFF, (1919), 1522 Aline St., New Orleans.

DURALDE F. WOODS, (1915), Civil Engineering, Lutcher, La.

HENRY L. ZANDER, (1898), Parish Engineer for Jefferson Parish, Engineer 1st and 2nd Good Roads Districts, Engineer 2nd and 5th Unit 4th Jefferson Drainage District, 821 N. Rampart St., New Orleans.

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JOS. P. BERANGER, (1915), Chief Engineer, West India Sugar Finance Corp., 129 Front St., New York City.

M. E. BERANGER, (1918), General Manager, Bernard Lodge Central, Grange Lane, Jamaica, B. W. I.

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JOS. M. BING, (1917), Consulting Engineer, 53 Hamilton Terrace, New York City.

A. L. BLACK, (C. M.), 58 Sutter St., San Francisco, Cal.

EDWARD W. BRES, (1915), Mechanical Engineer, 1119 Short St., New Orleans.

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FRANCIS T. FOOTE, (1909), Lumber Business, Kaplan, La.

LOUIS J. FORTIER, (1914), Captain of Field Artillery, Alabama Polytechnic Institute, Auburn,Ala.

JAMES McC. FOURMY, (1916), Consulting Highway Engineer, Hammond, La.

FRED. I. GETTY, (1915), Manufacturer of Oil Well and Water Well Supplies, Strainers, Pumps, etc., 603 Cutting Ave., Jennings, La.

FLOYD HAMILTON, (1919), Lake Charles, La.

ADOLPH E. HARTMAN, (1918), Geologist, Gypsy Oil Co., Tulsa, Okla.

JOHN LOVEJOY HENNING, (1919), 525 Kirby St., Lake Charles, La.

H. H. HOLLOWAY, (1919), Civil Engineer, Bunkie, La.

MARION C. HUCKABY, (1920), Highway Engineer, Covington, La.

CHARLES L. JACOB, (1911), 600 Kerlerec St., New Orleans.

E. S. JARRETT, (1909), President, Jarrett-Chambers Co., Inc., Contractors, 30 East 42nd St., New York City.

JOHN M. JENKS, (1920), Box 64, Bay St. Louis, Miss.

XAVIER A. KRAMER, (1911), Consulting Engineer, Magnolia, Miss.

L. A. LOUSTALOT, (1913), Civil Engineer, Franklin, La.

HENRY A. MENTZ, (1915), Consulting Electrical and Mechanical Engineer, Magnolia, Miss.

JULIAN DUNBAR MONETTE, (1921), Assistant Highway Engineer, Covington, La.

ROBERT MORRISON, (1919), Cut Off, La.

HERBERT H. McGEHEE, (1920), Box 224, Arcadia, La.

CHARLES W. OKEY, (1911), Engineer, Elliott & Harmon Engineering Co., 245 Ayres Ave., Peoria, Ill.

WILLIAM C. OLSEN, (1914), Consulting Municipal Engineer, Sumter, S. C.

GUY OSBORNE, (1913), Gable, S. C.

BOYKIN W. PEGUES, (1907), Professor of Civil Engineering, Louisiana State University, Baton Rouge, La.

H. N. PHARR, (1908), Sugar Planter and Manufacturer, Olivier, La.

H. A. PHILIPPI, (1912), Civil Engineer, 213 New Orleans Court Bldg., New Orleans.

OTTO F. REISZNER, (1916), General Engineering Practice, Lecompte, La.

FRANK LOUIS REYNOLDS, (1919), Associate Member, A. S. C. E., Vice-President Fox, Reynolds Co., Inc., Building Construction, 81 East 125th St., New York City.

W. B. ROBERT, (1911), Civil Engineer, Lafayette, La.

FRANK L. ROE, JR., (1920), Omega, Madison Parish, La.

ERNEST A. ROSE, (1915), care The Dyer Co., Cleveland, Ohio.

JOHN A. SALMEN, (1911), Vice-President, Salmen Brick & Lumber Co., Ltd., Slidell, La.

T. H. SAMPSON, (1900), Manufacturer of Sampson Process Gum Lumber, Helena, Ark.

REGINALD McC. SCHMIDT, (1915), Junior Engineer, 4th District, Mississippi River Commission; 1023 Leontine St., New Orleans.

HARRY D. SCOTT, (1920), Trujillo, Honduras, C. A.

GEORGE SELMAN, (1908), Surveying and Engineering, Box 596, Monroe, La.

HOBART D. SHAW, (1917), City Engineer and General Practice, Gulfport, Miss.

ELMER E. SHUTTS, (1918), Lake Charles, La.

FRANK SHUTTS, (1913), Lake Charles, La.

FRED N. SHUTTS, (1913), Highway Engineer, Calcasieu Parish, Lake Charles, La.

JOHN A. SILSBEE, (1915), of Gilbert & Silsbee, Civil and Consulting Engineers, Okmulgee, Okla.

FRED E. SMITH, (1916), 1944 Louisa St., New Orleans.

THOMAS BAKER SMITH, (1919), Houma, La.

JOHN Y. SNYDER, (1918), Engineer, 1210-1211 Merchants Bldg., Shreveport, La.

ROGER B. STEVENS, (1920), Engineer, Consulting Board, American Sugar Refining Co., 117 Wall St. New York, City.

IRA W. SYLVESTER, (1901), Consulting Engineer, City Hall Bldg., Alexandria, La.
WM. F. TRIGGS, (1914), Gueydan, La.
THOS. H. TUTWILER, (1898), President and General Manager, The Memphis Street Railway Co., Memphis, Tenn.
WM. VON PHUL, (1908), (Ford, Bacon & Davis), President and General Manager, United Railroads of Son Francisco, 58 Sutter St., San Francisco, Cal.
BUFORD E. WALKER, (1919), Pascagoula, Miss.
ALLEN E. WASHBURN, (1908), Port Eads, La.
JOHN LESTER WHITE, (1920), Lecompte, La.
W. S. WHITE, (C. M.), 918 Parkerson Ave., Crowley, La.
MAYBIN H. WILSON, (1912), Captain, U. S. A., First Engineers, Co. B, (Railway Operating), Coblentz, Germany. Home Address, 1221 Constantinople St., New Orleans.
PEYTON W. WOOD, (-911), Sales Engineer, Buda Co., Harvey, Ill.
A. A. WOODS, (1911), Chief Engineer Maintenance of Way and Structures, Southern Ry. System, Lines West; 131 Ingalls Bldg., Cincinnati, Ohio.
SAMUEL YOUNG, (1911), Chief Engineer, P. O. Box 41, Little Rock, Ark.

ASSOCIATE MEMBERS.

R. H. BAUMBACH, (1911), Manager, Eugene Dietzgen Co., 615 Common St., New Orleans.
JOSEPH A. BRENNAN, (1920), care Fuller Co., St. Charles and Union Sts., New Orleans.
E. C. BROWN, (1915), Sales Engineer, 3820 St. Charles Ave., New Orleans.
LEWIS McCLELLAN DALGARN, (1921), 1517 Nashville Ave., New Orleans.
H. W. FLETCHER, (1913), Manager, Clyde Iron Works Sales Co., 309 Magazine St., New Orleans.
GEORGE B. GIBSON, (1920), 1934 St. Roch Ave., New Orleans.
EDMUND J. GLENNY, (1919), 1435 Webster St., New Orleans.
GEORGE J. GLOVER, (1916), General Contractor, 1022-23 Whitney Bank Bldg., New Orleans.
JULES GODCHAUX, (1899), Godchaux Bldg., New Orleans.
A. T. GOMILA, (1920), General Pershing St., New Orleans.
WALTER F. JAHNCKE, (1920), 814 Howard Ave., New Orleans.
A. A. KEITHER, (1919), 234 S. Scott St., New Orleans.
EDWARD T. MALLOY, (1920), 4117 St. Peter St, New Orleans.
JOHN McINERNEY, (1920), Builder, Liberty Bank Bldg., New Orleans.
EDWIN L. POWELL, (1914), President, New Orleans Coffee Co., 1531 Exposition Blvd., New Orleans.
JOHN J. STEADMAN, (1912), Supervisor Bridges and Buildings, N. O. & N. E. R. R., Room 308, Ross Bldg., Hattiesburg, Miss.
F. W. STEVENS, (1909), Manager New Orleans District Sales Office, Allis-Chalmers Mfg. Co., 719 Maison Blanche, New Orleans.
JAMES W. SPENCE, (1921), 506 Nashville Ave., New Orleans.
STILLMAN W. WHEELOCK (1914), Manager of Sales, Carnegie Steel So., 1030 Maison Blanche Bldg., New Orleans.

RESIDENT JUNIOR MEMBERS.

JOHN APPLEBY, JR., (1918), Assistant Engineer, A. M. Shaw, 617 Common St., New Orleans; 1518 Melpomene St., New Orleans.
HENRY HESTER BATE, (1919), Civil Engineer, 1330 Pine St., New Orleans.
J. J. BULLUING, (1915), Market Street Power House, New Orleans.
HORATIO L. GILBERT, (1917), 77908 Sycamore St., New Orleans.
EUGENE C. GRAVELEY, (1918), Civil Engineer, 1302 Marengo St., New Orleans.
H. M. HAYNE, (1914), 3222 Prytania St., New Orleans.
MAURICE F. HUNT, (1919), 3629 Chestnut St., New Orleans.
S. DOUGLAS JACKSON, (1916), Sales Engineer, A. M. Lockett & Co., 521 Baronne St., New Orleans.

JOSEPH W. JOACHIM, (1919), 636 Second St., New Orleans.
WILHELM EMIL KOCH, (1913), Civil Engineer, 2627 Coliseum St., New Orleans.
R. B. KOHNKE, (1911), Civil Engineer for Island Refining Corporation, P. O. Box 22, Sellers, La.
ALEX H. McCOMISKEY, JR., (1919), 2837 Carondelet St., New Orleans.
SHEPARD F. PERRIN, (1915), Mechanical Engineer, Doullut & Williams Shipbuilding Co., 3804 Chestnut St., New Orleans.
ROBERT A. PIERPONT, (1915), 1036 Napoleon Ave., New Orleans.
CLIFFORD HOEY STEM, (1914), Industrial Engineer, Hudson Motor Car Co., 2016 Jefferson Ave., East, Detroit, Mich.
STEPHEN A. THEARD, (1920), Oak Grove, La.
ANDREW J. WILD, JR., (1918), 2606 Essex Ave., Nashville, Tenn.
CHARLES S. WYLER, (1919), 530 Jackson Ave., New Orleans.

NON-RESIDENT JUNIOR MEMBERS.

GEORGE O. ALLAIN, JR., (1916), Toll Plant, Cumberland Telephone and Telegraph Co., 6214 St. Charles Ave., New Orleans.
G. C. BADGER, (1913), Chief Engineer, Grimnell Company of the Pacific, 453 Mission St., San Francisco, Cal.
F. R. DUVIC, (1916), Engineer, with U. S. Engineer Office, Q. & C. Bldg., New Orleans.
JACOB F. MULLER, JR., (1912), Engineer American Cast Iron Pipe Co., Birmingham, Ala.
HERBERT P. NATHAN, 1913), Engineer, Union Oil Co., Los Angeles, Cal.; 439 Duquesne Ave., Culver City, Cal.
CARL SCHNEIDER, (1916), Superintendent Mechanical Plant, Bureau of Standards, Washington, D. C.
LUCIEN J. TROXLER, JR., (1915), Radio Division, Bureau of Engineering, Navy Department; 2008 G St., N. W., Washington, D. C.

STUDENT MEMBERS.

ROBERT L. ATKINSON, 312 Audubon Blvd., New Orleans.
WALTER COOKE, 1025 Alvar St., New Orleans.
JOHN R. DYKERS, 8320 Sycamore St., New Orleans.
JOSEPH M. GWINN, JR., 7405 Burthe St., New Orleans.
EUGENE C. HAWKINS, 2320 Cambronne St., New Orleans.
C. L. JONES, 1539 Jackson Ave., New Orleans.
RALPH H. MANN, 1334 Henry Clay Ave., New Orleans.
FRANK A. TURNER, 1230 Park Ave., Alexandria, La.
VENARD WILSON, 1st. Lieut. 83rd. F. A., Camp Knox, Ky. Home Adrdess, 1221 Constantinople St., New Orleans.
LOUIS J. WYLER, 530 Jackson Ave., New Orleans.

SUMMARY.

Honorary Member	1
Resident Members	150
Non-Resident Members	79
Associate Members	19
Junior Members	19
Non-Resident Junior Members	7
Student Members	10
Total	285

PAST OFFICERS.

Presidents.

Sidney F. Lewis.....1898
Thos. L. Raymond.....1899
Henry J. Malochee.....1900
Frank M. Kerr.....1901
Alf. F. Theard.....1902
Alf. Raymond.....1903
J. F. Coleman.....1904
W. B. Wright.....1905
W. H. Hoffman.....1906
G. W. Lawes.....1907
C. W. Wood.....1908
J. T. Eastwood.....1909
W. B. Gregory.....1910
J. C. Haugh.....1911
D. S. Anderson.....1912
A. M. Shaw.....1913
W. H. Williams.....1914
L. C. Datz.....1915
Samuel Young.....1916
A. T. Dusenbury.....1917
John Klorer.....1918
Ole K. Olsen.....1919
John Riess.....1920

Vice-Presidents.

C. H. Chamberlain.....1898-1899
Alf. F. Theard.....1900
J. F. Coleman.....1901
W. B. Wright.....1902-1903
W. T. Crotts.....1904
J. M. Ordway.....1905
G. W. Lawes.....1906
C. W. Wood.....1907
J. T. Eastwood.....1908
John Riess.....1909-1910
A. M. Lockett.....1911-1912
Wm. H. Williams.....1913
Ole K. Olsen.....1914
Samuel Young.....1915
A. T. Dusenbury.....1916
John Klorer.....1917
R. S. Manley.....1918
John Riess.....1919
R. S. Manley.....1920

Secretary and Librarian.

J. F. Coleman.....1898-1899
Gervais Lombard.....1900
John F. Richardson.....1901
G. W. Lawes.....1902-1903-1904-1905
Marcel Garsaud.....1906
L. C. Datz.....1908
L. C. Datz.....1909
L. C. Datz.....1910
L. C. Datz, Jas. M. Robert.....1911
James M. Robert.....1912
James M. Robert.....1913
W. T. Hogg.....1914-1915-1916
J. M. Robert.....1917
J. M. Robert.....1918-1919-1920

Treasurers.

Alf. F. Theard.....1898-1899
Walter H. Hoffman.....1900-1901
R. E. DeBuys.....1902
W. H. Hoffman.....1903-1904-1905
J. C. Haugh.....1906-1907-1908
J. C. Haugh.....1909-1910
J. M. Robert, Ole K. Olsen.....1911
Ole K. Olsen.....1912-1913
E. H. Coleman.....1914-1915-1916
John Klorer.....1916
Ole K. Olsen.....1917-1918
Walter B. Moses.....1919-1920

Directors.

Thos. L. Raymond.....1898
A. C. Bell.....1898-1899
F. T. Llewellyn.....1898
Frank M. Kerr.....1899-1900
Alf. Raymond.....1901-1902
Ernest D. Ivy.....1900-1901-1902
T. H. Tutwiler.....1900-1901
A. M. Lockett.....1910
A. M. Shaw.....1911-1912-1914
L. C. Reed.....1910-1911-1912
D. S. Anderson.....1911-1912
W. B. Gregory.....1912-1913-1914-1915-1916
L. C. Datz.....1912-1913-1914-1916
A. T. Dusenbury.....1913-1914

Henry J. Malochee	1899
John M. Ordway	1902-1903-1904
A. C. Duval	1903-1904-1905
W. McCorkindale	1903
C. W. Wood	1904-1905-1906
E. L. Jahncke	1905-1906-1907
John Riess	1907-1908-1917
W. B. Gregory	1909
Marcel Garsaud	1908-1909-1910
J. W. Armstrong	1909-1910
Ole K. Olsen	1915-1916
W. H. Williams	1915
R. S. Manley	1916-1917
Samuel Young	1917
J. M. Robert	1917
H. L. Hutson	1918
John Riess	1918
J. S. Barelli	1918
R. T. Burwell	1919
C. S. Williamson	1920

DECEASED

CHARLES H. DICKINSON, C. M., December 13, 1898.
EDGAR L. LAMBERT, R. M., March, 1901.
H. BOLIVAR THOMPSON, C. M., July 10, 1901.
THOS. L. RAYMOND, C. M., November 15, 1901.
GEO. A. LEDERLE, R. M., March 27, 1905.
JOHN T. NORTON, R. M., July, 1905.
FRANCIS V. PELLERIN, R. M., March 31, 1908.
JUDGE JOHN CLEGG, Assoc. M., October 5, 1908.
JOHN MORSE ORDWAY, Hon. M., July 4, 1909.
HENRY B. RICHARDSON, C. M., August 22, 1909.
CHARLES W. WOOD, R. M., Aprily 3, 1911.
BENJAMIN MORGAN HARROD, C. M., September 7, 1912.
JOHN D. WHITE, N. R. M.
JAMES C. HAUGH, R. M., July 6, 1913.
J. C. HENRY, N. R. M., December, 1914.
REINNIER SWART, N. R. M., August, 1917.
FOSTER OLROYD, R. M., October, 1917.
C. W. BOCAGE, N. R. M., August, 1918.
A. A. DIETTEL, N. R. M., August 6, 1918.
ROBERT W. NOLTE, R. M., October 9, 1918.
DAVID W. WEIDMAN, Jr., M., October 18, 1918.
C. H. GILLEAN, N. R. M., November 9, 1918.
W. J. HARDEE, C. M., November 17, 1918.
GAIL H. BROWNE, N. R. M., December 7, 1918.
A. HAROLD DELBERT, Jr., M., January 6, 1919.
HENRY L. HUTSON, R. M., January 10, 1919.
C. T. RAYNER, JR., R. M., January 20, 1919.
CHARLES O. BABIN, R. M., February 13, 1919.
E. B. McKINNEY, R. M., March 30, 1919.
W. B. WRIGHT, R. M., November 16, 1919.
ALFRED RAYMOND, R. M., January 13, 1920.
HERBERT M. FIELD, R. M., April 10, 1920.
ARSENE PERRILLIAT, R. M., October 23, 1920.
W. A. HALLER, N. R. M.

CATALOGUE OF BOOKS—LOUISIANA ENGINEERING SOCIETY LIBRARY, FEBRUARY 1, 1921.

Aerial Navigation

Aerobatics. 1918—Baker, H.
The Aerial Arm. 1919—Gill, N. J.
Building and Flying an Aeroplane. 1917—Hayward, C. B.
Practical Aviation. 1919—Hayward, C. B.
Practical Flying. 1918—McMinnies, W. G.
A.-B.-C. of Aviation. 1918—Pagé, V. M.
Aviation Engines. 1919—Pagé, V. M.
Air Plane Design and Construction. 1919—Pomilio, O.
Practical Aviation. 1918—White, J. A.
Applied Aeronautic Engineering. 1920—Woodhouse, H.

Applied Mechanics—Engineering Materials

Proceedings and Technical Papers—American Society for Testing Materials.
Timber, its Strength, Seasoning and Grading. 1919—Betts, H. S.
Experimental Engineering and Manual for Testing. 1913—Carpenter & Gardner.
Corrosin and preservation of Iron and Steel. 1910—Cushman & Gardner.
Applied Mechanics. 1915—Fuller & Johnson.
Structural Details or Elements of Design in Timber Framing. 1914—Jacoby, H. S.
Materials of Construction. 1907—Johnson, J. B.
Text-book of the Materials of Engineering. 1917—Moore, H. T.
Structure & Properties of the More Common Materials of Construction. 1916—Upton, G. B.

Bridges and Roofs—Viaducts

Principles of Economy in Design of Metalic Bridges. 1891—Bender, C. B.
Theory and Design of Modern Frame Structures. 1916—Bryan, C. W. and others.
Graphic Lines by Influence Lines for Bridges and Roof Construction. 1905—Burr, W. H. and Folk, M. S.
Mechanic of Internal Work. 1916—Church, S. P.
Allowable pressure on Deep Foundations. 1907—Corthell, E. L.
Engineering and Building Foundations. 1920—Fowler, C. E.
Trusses and Arches Analyzed by Graphic Methods. 1910—Greene, C. E.
Wharves and Piers. 1917—Greene, C.
Retaining Walls. 1913—Howe, M. A.

Complete Treatise on Cost and etc., of Wrought Iron Bridge Construction. 1864—Humber, W.

Foundation for Bridges and Buildings. 1914—Jacoby, H. andDavis, R. P.

Theory and Practice of Modern Framed Structures. 1904—Johnson, J. B. and others.

Design of Steel Mill Buildings. 1915—Ketchum, M. S.

Design of Steel Bridges. 1915—Kunz, F. C.

Text-book on Roofs and Bridges. 1914—Merriman, M. and Jacoby, H. S.

Theory and Calculation of Continuous Bridges. 1876—Merriman, M.

Design and Detailing of Simple Steel Structures. 1914—Morris, C. T.

Report on Movable Bridges as Used in Europe. 1895—New York Engineering & Survey Department.

Bridge Engineering. 1916—Waddell, J. A. L.

Building Materials and Construction

Treatise on Masonry Construction. 1913—Bake.

Cement, Lime, Plaster. 1907—Echel.

Dilapidations. 1891—Fletcher, B.

Fire Prevention and Protection as Applied to Building Construction. 1912—Freitag.

The Distribution of Gas. 1912—Hole, W.

Design of Walls, Bins and Grain Elevators. 1913—Ketchum.

Building Construction and Superintendence. 1903—Kidder.

Stone. 1890—Luard.

Fire Prevention and Fire Protection During Construction. 1918—National Fire Protection Association.

Outside Stairs for Fire Exits. 1916—National Fire Protection Association.

Structural Defects. 1916—National Fire Protection Association.

Water Distribution Systems and Fire Protection. 1917.—National Fire Protection Association.

Science of Building. 1870—Thom.

Preservation of Structural Timber. 1915—Weiss.

Business Management

American Mine Accounting. 1913—Charlton, W. H.

Manufacturing Costs and Accounts. 1917—Church, A. H.

Factory Organization and Administration. 1914—Diemer, H.

Engineering Valuation of Public Utilities. 1913—Foster, H. A.

Effective Business Letters. 1920—Gardner, E. H.

New Construction Methods. 1919—Gardner, E. H.

Financial Engineering. 1920—Goldman, O. B.

Developing Executive Ability. 1919—Gowin, E. B.

Modern Management Applied to Construction. 1918—Hauer.

Indexing and Filing. 1919—Hudders, E. R.

Investigating an Industry. 1914—Kent, W.

Bookkeeping and Cost Accounting in Factories. 1918—Kent, Wm.
Accounting. 1920—Kester, R. B.
Principles of Industrial Organization. 1913—Kimball, D. S.
Geeting the Most Out of Business. 1919—Lewis, E. St. E.
Auditing. 1920—Montgomery.
Selling Your Services. 1920—Pearson, G. C.
Purchasing. 1915—Rindsfoos, C. T.
American Methods in Foreign Trade. 1919—Vedder, G. C.

Canal Engineering

Practical Irrigation. 1908—Bowie, A. J., Jr.
Report on Irrigation. 1920—Columbia Basin Survey Commission.
Irrigation Works Conducted by the United States Government. 1917 —Davis, A. P.
Irrigation Engineering. 1919—Davis, A. P. & Wilson, H. M.
Engineering for Land Drainage. 1913—Elliott, C. G.
Practical Farm Drainage. 1919—Elliott, C. G.
Irrigation Practice and Engineering. 1915—Etcheverry, B. A.
Operation & Maintenance of Irrigation Systems. 1917—Harding, S. T.
Irrigation in the United States. 1906—Newell, F. H.
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Canal. 1897—New York Engineer & Survey Department.
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Report. 1895—U. S. Nicaragua Canal Board
Letter of Secretary of War Transmitting First Annual Report of Isthmian Canal Commission. 1904—U. S. War Department.
Irrigation Engineering. 1915—Wilson, H. M.

Chemical Technology

Steel and Its Heat Treatment. 1918—Bullens, D. K.
Petroleum Refining. 1918—Campbell, Andrew.
Methods of Textile Chemistry. 1918—Dannerth, F.
Paint Technology and Tests. 1911—Gardner, H. A.
Soil Alkali. 1920—Harris, F. T.
Powdered Coal as a Fuel. 1918—Herington, C. F.
Denatured or Industrial Alcohol. 1907—Herrick, R. F.
Examination of Hydro-Carbon Oil, Saponifiable Fats and Waxes 1915—Hodle, D.
Composition and Heat Treatment of Steel. 1911—Lake, E. F.
Coal-tar and Ammonia. 1916—Lunge, G.
Scrap Metals. 1918—Manlore, G. H.
Oxy-Acteylene Welding & Cutting. 1916. Manly, H. P.

White Lead. 1920—Sabin, A. H.
Non-technical Chats on Iron and Steel. 1917—Spring, L. W.
Technical Gas and Fuel Analysis. 1913—White, A. H.

Civil Engineering

J. E. Aldred Lectures on Engineering Practice. 1917—Johns Hopkins University Engineering Department.
Annales du Genie Civil. 1867—Lacroix, E.
A Treatise of Civil Engineering. 1902—Mahan, A.
Elementary Course of Civil Engineering. 1886—Wheeler, J. B.

Commerce and Communication

American Railway Accounting. 1918—Adams, H. C.
Report on the Street Railway Service of City of New Orleans. 1917—Allison, J. C.
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Concrete

Concrete Construction, Methods and Cost. 1908—Gillette, H. P. and Hill, C. S.
Reinforced Concrete Construction. 1916—Hool, G. A.
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Properties and Design of Reinforced Concrete. 1887—Martin, N.
Notes on Concrete and Works in Concrete. 1887—Newell, J.
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Concrete Construction for Rural Communities. 1918—Seaton, R. A.
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Concrete Costs. 1912—Taylor, F. W. and Thompson, S. E.
Treatise on Concrete Plain and Reinforced. 1912—Thompson, S. C. and Taylor, F. W.
Principles of Reinforced Concrete Construction. 1914—Turneau, F. E. and Maurer, E. R.
Principles of Reinforced Concrete Construction. 1919—Turneau, F. E. and Maurer, E. R.
[illegible]ncrete Stone Manufacturer. 1918—Whipple, H.
[illegible]w To Do It. 1919—Whipple, H. comp.

Contracts and Specifications

Engineering Contracts and Specifications. 1904—Johnson, J. B.
Standard Specifications for Structural Steel. 1911—Ostrup, J. C.

Designs and Drawings

Structural Drafting and the Design of Details. 1920—Bishop and Charlton.
Text book of Free Hand Lettering. 1907—Daniles, F. T.

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Lessons in Mechanical Drawing Prepared for the Scientific American. 1879—Maccord, C. W.

Elementary Machine Drawing and Design. 1912—Marshall, W. C.

Electrical Engineering

Wiring of Finished Buildings. 1915—Croft, T.

Practical Helps for the Electric Railway Shop. 1919—Electric Railway Journal. comp.

Elements of Electrical Engineering. 1907—Franklin, W. S. and Estty, Wm.

Engineering of Power Plants. 1916—Fernald, R. H. and Orrock, G. A.

Long Distance Electric Power. 1907—Hutchinson, R. W.

Principles of Radiography. 1919—Jansky, C. M.

Principles of the Telephone. 1916—Jansky, C. M. and Faber, D. C.

Handbook of Electrical Testing. 1881—Kemp, H. R.

Radio Engineering Principles. 1920—Lauer, H. and Brown, H. L.

American Telephone Practice. 1905—Miller, K. B.

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American Telephone Practice. 1905—Miller, K. B.

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Electricity and Magnetism for Engineers. 1918—Pander, H.

Notes on Hydro-Electric Developments. 1908—Player, P.

Practical Calcilation of Transmission Lines for Distribution of Direct and Alternate Currents. 1909—Rosenthal, S. W.

Hydro-electric Power Station. 1917—Rushmore and Lof.

Hydro-electric Practice. 1911—Schon, H. A. E. C. Von.

Automatic Telephony. 1914—Smith, A. B. and Wilson, W. L.

Electric Power Transmission. 1919—Still, A.

Engineering Mathematics. 1911—Steinmetz, C. P.

Electric Power Plant Engineering. 1913—Weingreen, J.

Economic Geology

American Petroleum in Industry. 1916—Bacon, Raymond and others.

Bibliographical Review and Index of Papers Relating to Underground Literature Published in the United States. 1905-1906—Fuller, M. L.

Bibliographical Review and Index of Papers Relating to Underground Waters. 1879-1904. 1905—Fuller, M. L.

Practical Oil Geology. 1919—Hager, D.

Principles of Oil and Gas Production. 1916—Johnson, B. L. and Huntley, J. T.

Report on Geology of Louisiana. 1902—Louisiana State Experiment Station.

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Prospecting for Oil and Gas. 1920—Panyity, L. S.

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Bulletins.—Texas University Mineral Survey.
Annual Reports. Supply and Irrigation Papers.—U. S. Geological Survey.
Handbook of Natural Gas. 1915—Westcott.
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Economics

When the Workmen Help You Manage. 1920—Basset, Wm. R.
Industrial Goodwill. 1919—Commons, J. R.
Efficiency as a Basis of Operation and Wages.—Emerson, H.
American Problems of Reconstruction. 1918—Freedman, E. M.
Industrial Leadership. 1916—Ganet, H. L.
Industry and Humanity. 1918—King, W. M. M.
Business Finance. 1919—Lough, W. H.
When Prices Drop. 1918—National Bank of Commerce in New York.
The Good Ship Earth. 1913—Quick, H.
Millions From Waste. 1920—Talbot, F. A.
Instincts in Industry. 1918—Tead, O.

Handbooks

Audel's Marine Engineer's Guide. 1918.
Waterworks Handbook. 1918—Bogert, C. L., and others.
Handbook of Chemistry and Physics. 1917—Coolbaugh & Hodman.
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MINUTES OF MEETING AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Board of Direction, December 13, 1920.

The regular meeting of the Board of Direction was held with Vice-President Manley in the chair and the following present: Messrs. Barelli, Lawes, Moses, Olsen, Williamson and Robert. Mr. Riess came in later and assumed the chair. The minutes of the previous meeting were read and approved.

The following applications were ordered to the ballot provided they receive the endorsement of the Membership Committee: Messrs. Joseph P. Borges, Lewis McC. Dalgarn, Julian D. Monette, Leo S. Weil.

The resignations of Messrs. J. S. Sharp and Frank J. Trelease were accepted. It was decided to write Mr. T. L. Willis a letter explaining the matter of Non-resident membership. (1920)

The report of the Secretary was read and approved and bills ordered paid.

There being no further business, the meeting adjourned.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Society, December 13, 1920.

The regular meeting was called to order with President Riess in the chair and 36 members and guests present. The minutes of the previous meeting were read and approved. Resolutions on the death of General Arsene Perrilliat were read by Mr. G. W. Lawes and these were ordered spread upon the minutes.

A statement was made by Mr. Moses concerning the annual smoker, and upon motion duly seconded, it was decided to hold the usual smoker on the second Saturday in January.

Short statements were made by Professor Gregory on the Federated American Engineering Society, by Mr. Olsen for the Membership Committee, and Major Shaw for the Refuse Disposal Committee.

Nomination for officers for the ensuing year were then in order and the following is a resume of the ballots:

PRESIDENT—

Manley	19
Shaw	3
Garsaud	1
Derickson	1
Williamson	1
Total	25

VICE-PRESIDENT—

Garsaud	6	5	....	....	....
Shaw	6	6	7	....	....
Nelson	7	19	14	14	13
Kerr	1	....	....	....	....
Williamson	1	....	....	....	....
Derickson	4	7	8	14	16
Dusenbury	1	....	....	....	....
Billingsley	1	....	....	....	....
O'Brien	1	....	....	....	....
Olsen	1	....	....	....	....
Totals	29	27	29	28	29

SECRETARY—

Robert	28
Total	28

TREASURER—

Moses	28
Total	28

BOARD MEMBER—

Nelson	15
Williamson	2
Shaw	9
Derickson	1
Billingsey	1
Total	28

As a result of the above ballots the following officers were nominated to serve for 1921: President, R. S. Manley; Vice-President, Donald Derickson; Secretary, J. M. Robert; Treasurer, Walter B. Moses, and member to serve on Board of Direction for three years, B. S. Nelson.

The technical exercises of the evening were then held and these consisted of a most interesting paper by Captain E. B. Latham on the "Work of the U. S. Coast and Geodetic Survey." After some little discussion of this the meeting adjourned to the usual collation.

JAMES M. ROBERT, Secretary.

ANNUAL REPORT OF THE SECRETARY.

Year 1920.

January 8, 1921.

To the Board of Direction, Louisiana Engineering Society:

Gentlemen:

As Secretary of the Society, I beg leave to submit the following report for the year 1920:

During the year the Board of Direction held nine regular and one special meeting. The Society also held nine regular meetings with an average attendance of 51; maximum 91, minimum 25. One special meeting of the Society was held.

The membership record for the year is as follows:

GRADE	On Roll Jan. 1, 1920	Elected	Reinstated	Transferred To	Transferred From	Dropped	Resigned	Died	On Roll Jan. 1, 1921
Honorary	1	0	0	0	0	0	0	0	1
Resident	145	15	2	3	2	3	6	4	150
Non-Resident	77	5	0	2	0	0	4	1	79
Associate	15	7	0	0	0	1	2	0	19
Junior	21	0	0	0	1	1	0	0	19
Non-Resident Junior	8	0	0	0	0	1	0	0	7
Student	7	5	0	0	2	0	0	0	10
	274	32	2	5	5	6	12	5	285

It is with regret that we report the deaths of Messrs. Alfred Raymond, W. B. Wright, H. M. Feild, and General Arsene Perrilliat, Resident Members, and Mr. W. A. Haller, Non-Resident member of the Society.

Submitted separately is the treasurer's report which shows a balance of $1,395.33.

Our investment account stands as follows:

Hibernia Bank and Trust Co.	$250.00
Metropolitan Bank	250.00
New Orleans National Bank	250.00
Interstate Bank & Trust Co.	250.00
Liberty Bonds	500.00
N. O. Bldg., La. State Fair	100.00
Total	$1,600.00

Attached are statements showing the financial condition of the Society:

The following technical exercises were held:

Feb. 9—Fabricated Steel Ship Construction as Developed by Doullut & Williams Shipbuilding, Inc., by James P. Ewin.

Mar. 8—Some notes on the Port of New Orleans, by J. F. Coleman.

Apl. 12—Lock Foundation, Inner Harbor Navigation Canal, New Orleans, Louisiana—The Problem and the Solution, by Col. G. R. Goethals.

May 10—Power Transmission Equipment, by William Crooks.

Sept. 13—Relation of Changes in Storm Tides on the Coast of the Gulf of Mexico to the Centre and Movement of Hurricanes, by Dr. I. M. Cline.

Oct. 11—Present Status of the Sewerage, Water and Drainage System of New Orleans, by George G. Earl.

Nov. 8—The Proposed Separation of the Red and Atchafalaya Rivers from the Mississippi and its effect on Flood Heights, by John Klorer.

Dec. 13—Work of the U. S. Coast and Geodetic Survey, by Captain E. B. Latham.

Your Secretary desires to thank you for your kind co-operation during the year. It has been an honor and privilege to serve you. I thank you.

Respectfully submitted,

JAMES M. ROBERT, Secretary.

FINANCIAL CONDITION OF THE SOCIETY, JANUARY 1, 1921.

Assets:		
Cash on hand	$1,395.33	
Membership Accounts Receivable	600.90	
Advertisers Accounts Receivable	310.81	
Investments	1,600.00	
Total assets		$3,907.04
Liabilities:		
Library Fund	$ 582.13	
Proceedings Reserve Fund	1,628.98	
1921 Dues	14.50	
1920 Dues Credited to 1921	3.00	
Accounts Payable	484.11	
Total liabilities		$2,712.72
Balance in General Fund		$1,194.32

General Reserve Fund.

Balance from 1914	$165.00
Balance from 1915	189.75
Balance from 1916	377.45
Balance from 1917	299.49
Balance from 1918	27.47
	$1,059.16
Deficit for 1919	62.93
	$ 996.23
Balance from 1920	198.09
	$1,194.32

Proceedings Reserve Fund.

Balance from 1915	$112.20
Balance from 1916	566.13
Balance from 1917	568.14
Balance from 1918	587.52
Balance from 1919	41.08
	$1,855.07
Deficit for 1920	226.09
	$1,628.98

Proceedings Fund—Result for Year 1920.

Revenues:		
Advertisements	$1,210.85	
Subscription — Membership	570.00	
Proceedings Sales	10.10	
Total revenues		$1,790.95
Expenses:		
Salary of Editor	$ 300.00	
Salary of Secretary	60.00	
Stenographer at meetings	22.50	
Assistant to Editor	180.00	
Miscellaneous Expense	18.15	
Printing and Mailing	1,422.25	
Losses through cancelled ads	14.14	
Total expenses		$2,017.04
Deficit		$ 226.09

General Fund—Result for Year 1920.

Revenues:		
Membership dues	$2,606.75	
Smoker	287.50	
Entrance Fees	323.00	
Exchange	.40	
Total Revenues		$3,217.65
Expenses:		
Subscription to Proceedings	$ 570.00	
Appropriation to Library	480.00	
Losses through various reasons; military service, non-payment of dues, etc	128.74	
Salary of Secretary	300.00	
Printing and Postage	317.05	
Refreshments	114.50	
National Public Works Assn	150.00	
Collector	29.28	
Miscellaneous Expense	149.98	
Smoker Expense	771.10	
Exchange	8.91	
Total expenses		$3,019.56
		$ 198.09

Annual Statement of Library Fund—January 1, 1921.

Revenues:

0

	Balance on hand January 1, 1921	$ 872.58	
	Revenue from General Fund	580.00	
	Total revenues		$1,352.58

Expenditures:

	Miss Carrie Freret, Salary	$ 140.00
Jan.	C. P. Eilerson	28.00
	Library Bureau	10.50
Feb.	Electrical World	5.00
Mar.	Amer. Society for Testing Materials	10.40
	Railway Age	5.00
	John Hopkins Press	3.00
	The Century Co	1.89
Apl.	McGraw-Hill Book Co	10.00
	Ronald Press Co	3.00
	Theo. Audel Co	14.40
May	Ronald Press Co	6.00
	Library Bureau	3.20
	McGraw-Hill Book Co	18.90
	John Wiley & Sons	7.90
	F. F. Hansell & Bro	66.50
June	Tulane University Press	10.30
	Electric Railway Journal	4.00
	John Wiley & Sons	25.95
	J. B. Lippencott Co	4.75
	Ronald Press Co	4.00
	Aeronautic Press Co	6.50
	Baker & Taylor Co	2.00
Aug.	McGraw-Hill Book Co	85.73
	Ronald Press Co	24.00
	Aeronautic Library, Inc	3.35
	Jordan-Goodwyn Corp.	1.85
	John Wiley & Sons	2.49
	Library Bureau	7.75
	Wm. P. Menard	13.00
	G. Gus Pilie	18.00
Sept.	McGraw-Hill Book Co	2.70
	Eugene Dietzgen Co	37.55
	Gaylord Bros.	2.25
	Aeronautic Library	7.65
Oct.	Missing Magazines	1.10
	American Society for Testing Materials	1.60
	Ronald Press Co	8.00
	John Wiley & Sons	9.20

	Miscellaneous Expense		3.50	
	McGraw-Hill Book Co.		7.20	
	Aeronautic Library		33.50	
	John Wiley & Sons		16.76	
Nov.	Kokosky & Co.		32.44	
	G. Gus Pilie		12.00	
	McGraw-Hill Book Co.		6.30	
Dec.	American Society of Mechanical Engs.		4.00	
	Electric Journal		2.00	
	Engineering & Contracting		4.00	
	Railway Maintenance Engineer		3.00	
	Railway Maintenance Engineer		3.00	
	Concrete		3.68	
	Bills Payable:—Kokosky Co.	$ 2.96		
	American Military Engs.	4.50		
	Miss Freret	15.00		
			22.46	
				$ 770.45
	Balance on hand, Jan. 1, 1921			$ 582.13

Cash Account.

Receipts:

1920 Dues	$2,103.30	
1919 Balances	482.05	
1921 Dues	14.50	
Entrance Fees	303.00	
Members reinstated	14.25	
Exchange	.40	
Smoker	252.50	
Advertisers in Proceedings	1,374.70	
Proceedings Sales	10.10	
Total receipts		$4,554.80
Deduct Exchange Charges		8.91
Net receipts		$4,545.89
Add 1919 Balance		1,213.79
		$5,759.68

Expenditures:

Total Warrants this year	$4,364.35
Balance on hand, Jan. 1, 1921	$1,395.33

Respectfully submitted,

JAMES M. ROBERT,
Secretary.

Annual Report of the Treasurer.

Year 1920

January 8, 1921.

To the President, Louisiana Engineering Society, City.

Dear Sir: As per requirements of Article No. 4 of the Constitution, I have the honor to submit the following report covering receipts and disbursements for the period of January 8th, 1920, up to and including January 8th, 1921.

Received from Secretary—	Deposited Citizens Bank	Deposited Whitney Bank	Exchange Charged
Jan. 14 Memo. 1 to 5	$ 651.91	....	$1.30
Feb. 2 Memo. 6 to 10	....	$ 546.34	1.15
Mar. 5 Memo. 11 to 12	....	239.65	.45
Apr. 9 Memo. 13 to 16	381.24	....	.64
Apr. 29 Memo. 17 to 21	....	462.64	.60
May 28 Memo. 22 to 26	379.22	....	.25
July 15 Memo. 27 to 31	319.14	....	.75
Aug. 18 Memo. 32 to 35	....	337.24	.72
Oct. 7 Memo. 36 to 39	355.02	....	.80
Oct. 29 Memo. 40 to 42	....	300.19	.75
Nov. 30 Memo. 43 to 45	292.10	....	.40
Dec. 29 Memo. 46 to 48	....	290.11	1.10
	$2,378.63	$2,176.17	$8.91

Total received Jan. 14, 1920 to Dec. 29, 1920	$4,554.80
Less exchange	8.91
	$4,545.89
Balance on hand as per Treasurer's Report, Jan. 8, 1920	1,213.79
	$5,759.68

Disbursements from January 8th, 1920 to January 8th, 1921.

January 14th—

No.	Name—	Amount
1	C. P. Eilerson	$ 28.00
2	Frank M. Norman	16.43
3	Walter B. Moses	723.60
4	Library Bureau	10.50
5	The Elliot Company	3.95
6	Engineering Pub. Company	2.00
7	Fabacher's Restaurant	15.00
8	M. Clay Le Jeune	14.00
9	Miss Carrie Freret	10.00
10.	Tulane University Press	157.50
11	Miss Edna Doll	15.00
12	James M. Robert	33.25

February 18th.—

13	Tulane University Press	56.35
14	Uriah J. Virgin	10.00
15	Garcia Stationery Co., Ltd	.75
16	Miss Carrie Freret	10.00
17	Miss Edna Doll	15.00
18	Frank B. Norman	8.25
19	Electrical World	5.00
20	James M. Robert	37.50
21	W. B. Gregory	150.00
22	Earle R. Knauer	10.00

March 11th—

23	American Society Testing Materials	10.40
24	Railway Age	5.00
25	Johns Hopkins Press	3.00
26	The Century Company	1.89
27	Miss Carrie Freret	10.00
28	Fabacher's Restaurant	11.30
29	Frank B. Norman	4.60
30	Kee Lox Manufacturing Co	3.00
31	Tulane University Press	32.40
32	Miss Edna Doll	15.00
33	James M. Robert	31.25

April 13th—

34	McGraw-Hill Book Company	10.00
35	The Ronald Press Company	3.00
36	Theo. Andel & Company	14.40
37	Miss Carrie Freret	10.00
38	Tulane University Press	272.90
39	Whitney Central Natl. Bank	4.00

	No.	Name—	Amount
	40	Fabacher's Restaurant	9.05
	41	Miss Edna Doll	15.00
	42	James M. Robert	36.25
May 12th—			
	43	Tulane University Press	263.60
	44	Ronald Press Company	6.00
	45	Library Bureau	3.20
	46	McGraw-Hill Book Company	18.90
	47	John Wiley's Sons, Inc	7.90
	48	F. F. Hansell & Bros., Ltd	66.50
	49	Fabacher's Restaurant	10.15
	50	Uriah J. Virgin	10.00
	51	Miss Carrie Freret	10.00
	52	Miss Edna Doll	15.00
	53	James M. Robert	47.00
June 23rd—			
	54	Tulane University Press	40.60
	55	M. Clay Le Jeune	7.00
	56	Fabacher's Restaurant	8.90
	57	Electric Railway Journal	4.00
	58	John Wiley & Sons, Inc	25.95
	59	J. B. Lippinscott Company	4.75
	60	Ronald Press Company	4.00
	61	The Aeronautic Library	6.50
	62	The Baker & Taylor Company	2.00
	63	Miss Carrie Freret	10.00
	64	Douglas Anderson	150.00
	65	Miss Edna Doll	15.00
	66	James M. Robert	33.25
August 2nd—			
	67	Tulane University Press	244.05
	68	McGraw-Hill Book Company	85.73
	6 9	Ronald Press Company	24.00
	70	Aeronautic Library, Inc	5.35
	71	Jordan-Goodwin Corporation	1.85
	72	John Wiley & Sons	2.49
	73	Library Bureau	7.75
	74	Wm. P. Menard	13.00
	75	G. Gus Pilie	18.00
	76	Miss Carrie Freret	30.00
	77	Miss Edna Doll	30.00
	78	James M. Robert	63.53
September 10th—			
	79	McGraw-Hill Book Company	2.70
	80	Eugene Dietzgen Company	37.55

No.	Name—	Amount
81	Gaylord Brothers	2.25
82	Miss Carrie Freret	15.00
83	The Aeronautic Library	7.65
84	Tulane University Press	102.65
85	Miss Edna Doll	15.00
86	James M. Robert	30.00
87	Tulane University Press	52.00
88	Technical Photographic Studies	25.00
89	Alfred C. Miranne	10.00
90	M. C. LeJeune	7.50
91	Miss Carrie Freret	18.50
92	Miss Edna Doll	15.00
93	James M. Robert	34.60
94	American Society Testing Materials	1.60
95	Ronald Press Company	8.00
96	John Wiley & Sons, Inc	9.20
97	McGraw-Hill Book Company	7.20
98	Aeronautic Library, Inc	33.50
99	John Wiley & Sons, Inc	16.76
November 10th.—		
100	Fabacher's Restaurant	33.80
101	Kokosky & Company	32.64
102	Miss Carrie Freret	15.00
103	Garcia Stationery Co., Ltd	1.00
104	Tulane University Press	6.00
105	Miss Edna Doll	15.00
106	James M. Robert	39.25
107	G. Gus Pilie	12.00
December 14th—		
108	Tulane University Press	371.55
109	M. C. Le Jeune	8.00
110	C. L. Jones	10.00
111	McGraw-Hill Book Company	6.30
112	American Society Testing Materials	4.00
113	Electric Journal	2.00
114	Engineering & Contracting	4.00
115	Railway Maintenance Engineer	3.00
116	Concrete	3.68
117	Miss Carrie Freret	15.00

118	Miss Edna Doll	15.00
119	Prof. D. S. Anderson	150.00
120	James M. Robert	35.00
	Total	$4,364.35

Total receipts	$5,759.68	
Total disbursements	4,364.35	
		$1,395.33
Check account in Whitney Bank January 8, 1921	599.51	
Check account Citizens Bank, January 8, 1921	795.82	
		$1,395.33
Deposit on 3% Certificate Hibernia Bank	250.00	
Deposit on 3% Certificate N. O. National Bank	250.00	
Deposit on 3% Certificate Interstate Bank	250.00	
Deposit on 3% Certificate Metropolitan Bank	250.00	
Interest accrued on these	75.00	
Five 4% Liberty Bonds—Citizens Bank	250.00	
Coupons not deposited	34.50	
Five 3½% Liberty Bonds—Whitney Bank	250.00	
Coupons not deposited	30.60	
One Share State Building, La. State Fair	100.00	
		$1,740.10
		$3,135.43

Respectfully submitted,

WALTER B. MOSES,
Treasurer.

The Proceedings of the
Louisiana Engineering Society

Published bi-monthly, February, April, June, August, October, December, under the auspices of the Committee on Publication.

DOUGLAS ANDERSON, Editor.

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Douglas Anderson, Editor, Tulane University,
New Orleans, La.

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LOUISIANA ENGINEERING SOCIETY

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Secretary,	J. M. ROBERT, Tulane University.
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The headquarters of the Society are in the State Museum Building, Jackson Square.

All business communications should be addressed to J. M. Robert, Secretary, P. O. Station 20, New Orleans, La.

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

VOL. VII | APRIL, 1921 | NO. 2

CONTENTS

EDITORIAL NOTES AND COMMENT: PAGE

Straightening a Turbo-Alternator Shaft ... 81
Financing a System of State Highways ... 82
The Proceedings Abroad ... 83
Engineers on the State Board of Health ... 83
Suggested Removal of Our Library ... 84
New Members ... 84

PAPERS AND DISCUSSIONS:

Straightening a Large Shaft by the Heat Process. *By Frank G. Frost* ... 85
Road Financing. *By Harry E. Gamble* ... 92
Discussion ... 100

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY ... 107

EDITORIAL NOTES AND COMMENT

Straightening a Turbo-Alternator Shaft. In a brief, but very interesting paper, read before the Society at the February meeting, Mr. Frank G. Frost, of the New Orleans Railway and Light Company, described the process of straightening a large shaft by what is known as the "Heat Process." This process consists in the application of intense heat locally to the convex side of the shaft at the point of maximum departure from true alignment. The portion subjected to the intense heat was of comparatively small area and the remaining portion of the shaft at the point of maximum curvature was packed with heat resisting materials, and in some cases ice was applied, in order to more effectually localize the heat upon the exposed convex part of the shaft. Successive applications of the heat were made until the maximum deflection of the shaft was reduced to such a small amount that upon the reassembling of the machine, and operation at full load, there was practically no vibration.

Indications are to the effect that the heat must be applied to a high degree of intensity, for comparatively short intervals of time, and to a reasonably small area of the shaft on the convex side. The successive steps in the process of straightening are indicated quite clearly by the curves.

Financing a System of State Highways. One of the most important problems in this state, as well as elsewhere, is that of the provision of and adequate and effective system of highways. The plan by which such a system of highways should be financed is receiving a considerable portion of the time and attention of the Constitutional Convention now in session at Baton Rouge. At the March meeting of the Society Hon. Harry E. Gamble delivered an address upon this subject, which is printed in this issue of the Proceedings.

Stressing the point that, in his opinion, the construction of highways is not strictly a governmental function, Mr. Gamble sets forth that the cost of highway construction should be borne by those who benefit from the construction. He makes three classes of these in a descending scale of the amount of benefit accruing to each class.

1. Those who use the roads either for pleasure or for business.

2. Those who own property immediately adjacent to a highway.

3. The general public in the sense that any improvement is a benefit to the state.

It is the opinion of Mr. Gamble that the proper basis upon which to proportion the cost of construction of a good system of highways is that the users of motor vehicles should pay two-thirds and the general property owners one-third. Based upon the assessed valuations for 1920 the property tax on automobiles is equivalent to a tax of about two-thirds of a mill upon the entire property valuation of the state. If this amount were remitted or contributed for the purpose of road construction, and if the automobile owners would agree to a vehicle tax of an average of $45.00 per car; then Mr. Gamble estimates that a sum of over $3,000,000.00 per year could be secured for the purpose of highway construction and maintenance.

As has often been pointed out, maintenance is the most important factor in the whole problem, and in the adoption of any system of financing this item should be given most prominent consideration.

The Proceedings Abroad. That our journal attracts notice in foreign countries as well as at home is evidenced by a request from an engineer in Berlin for a copy of the August 1916, issue, containing Mr. Hamilton's paper on "Wood Block Paving." the gentleman making the request is Dr. Ing. Friedrich Moll, Brandenburgischestrasse 21, Sudende-Berlin, Germany.

Engineers on the State Board of Health. A resolution, introduced by Mr. G. W. Lawes, and which will probably be passed by the Society, provides for representation of the engineering profession on the State Board of Health. The wording of the resolution is as follows:

Whereas: The protection and conservation of the public health is of paramount importance in the industrial and commercial development of the State, and in the maintenance of happiness, contentment and prosperity of its people, and,

Whereas: Discoveries in Sanitary Science have lead to developments and activities in public work, particularly in the field of environmental sanitation, that are not medical in their nature; for example, water supply and water purification, sewerage and sewage disposal, waste disposal, stream pollution, drainage for malaria control, ventilation ,etc., and

Whereas: Under the present constitution membership on the body having charge of the public health is limited to physicians, therefore

Be it Resolved, That the *Louisiana Engineering Society* recommend to the Constitutional Convention now in session, that this limitation be removed and that provision be made for representation of the engineering profession on this Board.

Suggested Removal of Our Library. Major Shaw thinks that the Library of the Society should be placed in some more central location near the business district of the city. He has been appointed an informal committee of one to investigate the feasibility of the idea with reference to securing a suitable location, of the probable cost of removal, new equipment and operation.

There is no disputing the fact that the Library in its present location, down at Jackson Square, is not of the service it should be to our members for reference and reading, nor of the service it would be were it located at some point where members could drop in on short notice and use the reference books and periodicals.

New Members. The Board of Direction has approved the applications for membership and transfer of the following men:

RESIDENT MEMBERS—Joseph P. Borges, with Jacques de Tarnowsky, structural engineer; Charles C. Crawford, Secretary and Sales Engineer, A. M. Lockett & Co.; Eugene N. Earhart, Chemical Engineer, Dunbar Molasses and Syrup Co.; Allen S. Hackett, Hackett-Garsaud Co.; Ector Brooks Latham*, Captain U. S. Coast and Geodetic Survey; Leo S. Weil, Engineering Sales Company; Walter E. Winship, Fuel Oil Business.

TRANSFER FROM JUNIOR TO RESIDENT MEMBER—Eugene M. Hornot, Chief Engineer, Gulf and Valley Cotton Oil Co.

NON RESIDENT MEMBERS—Waddy Thompson Drew, Highway Engineer; Julian D. Monette, Highway Engineer; Roger Irving Tanner, Private Practice, Abbeville, La.

ASSOCIATE MEMBERS—Lewis McC Dalgrarn, Contractor; Howard Harrington Marsh, District Manager, Simmons-Boardman Publishing Company; James W. Spence, Engineering Sales Company.

STUDENT MEMBER—Simon Bernard Schwartz, Senior, College of Engineering, Tulane University.

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*Deceased.

PAPERS AND DISCUSSIONS

STRAIGHTENING A LARGE SHAFT BY THE HEAT PROCESS.

By Frank G. Frost.

Read before the Society, February 16, 1921.

In the Market street generating station, of the New Orleans Railway & Light Company, we have a 3,000 K.W. 6600 V 60 cycle, 720 R.P.M. vertical Curtiss turbo-generator, manufactured by the General Electric Co., that was installed in 1907. This machine was built in the days when turbo-generators were given a nominal rating, and the steam end has sufficient capacity for from fifty to one hundred per cent overload, and the generator will carry twenty-five per cent overload continuously and fifty per cent overload for two hours. Such a unit today would be given a maximum rating of about 400 K. W.

When this machine was first put in service, it operated very satisfactorily, but sometime during its first few years of operation, it evidently received a strain from a short circuit or some other cause, which resulted in a sprung shaft. In 1918, this shaft was indicated as accurately as possible, without dismantling the machine and it was found that it was sprung anywhere from twenty to fifty thousands of an inch. The machine would not operate without excessive vibration and would carry only approximately sixty per cent of its rated capacity, and was very uneconomical and unreliable.

The station load had been growing to such an extent that in the early part of 1920, it was evident that it would be necessary to have all of the generating equipment in as good operating condition as possible, in order to successfully meet the maximum demand of the coming winter. A new shaft for this unit would cost approximately Ten Thousand ($10,000.00) Dollars, and would require from six to eight months to get delivery. The General Electric Co. for the past two or three years have successfully straightened similar shafts by the heat process, and after thoroughly discussing this matter, it was decided to make an effort to straighten this shaft, the work to be done under the supervision of a representative of the General Electric Co.

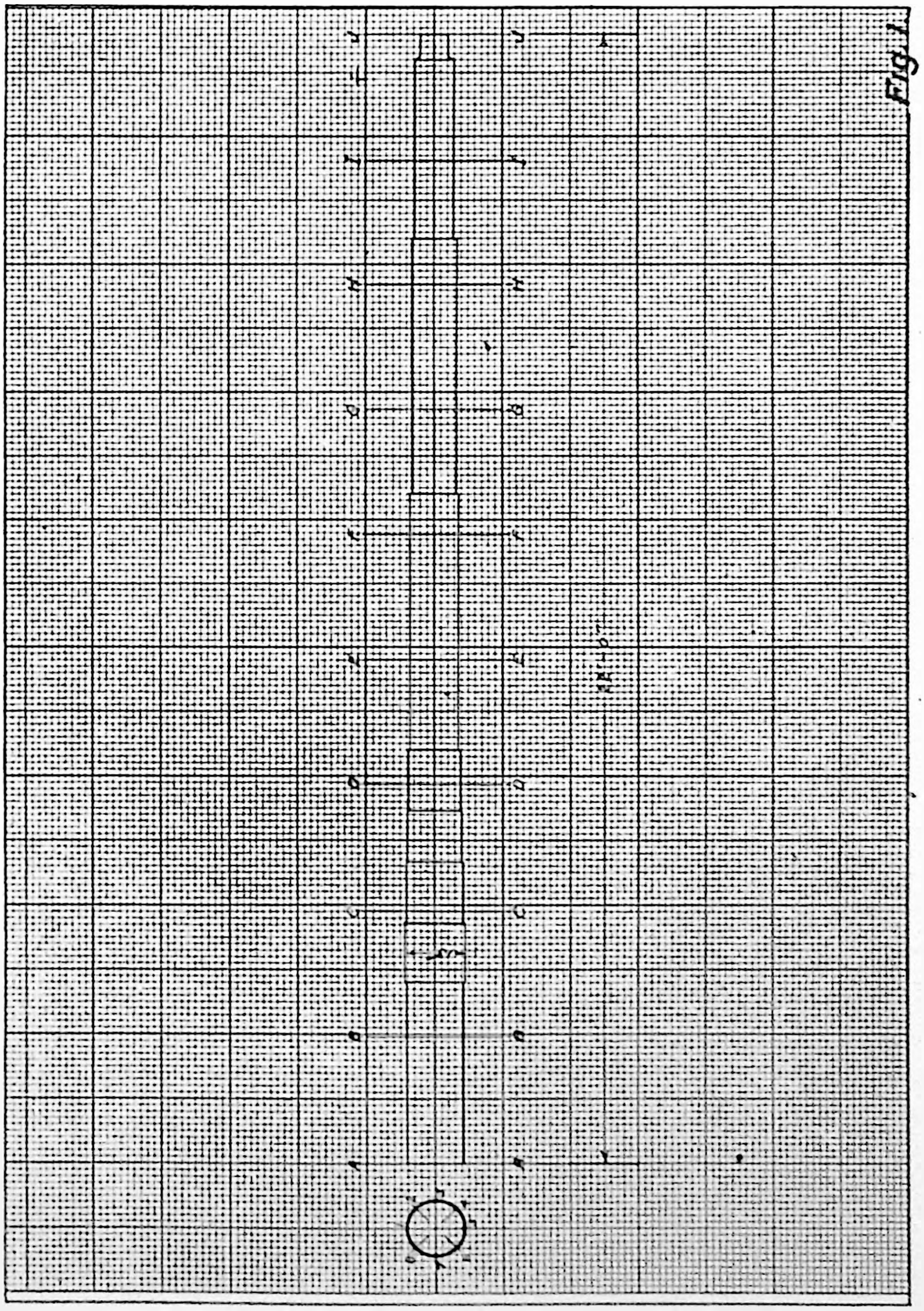
At the time that this work was done, it was not contemplated that the process would be described in a paper such as this, or more complete data, such as temperatures, deflections, analysis of the steel, etc., would have been recorded. Sufficient data was put on record to show the change of the center line of the shaft under the various heat treatments, all of which will be described in detail.

The turbine was dismantled early in March and the shaft, sketch of which is shown in Fig. 1, was mounted in a lathe, the end J. being chucked and the end A supported with the tail stock center. The shaft was now accurately indicated to determine at what points and the amount it was sprung.

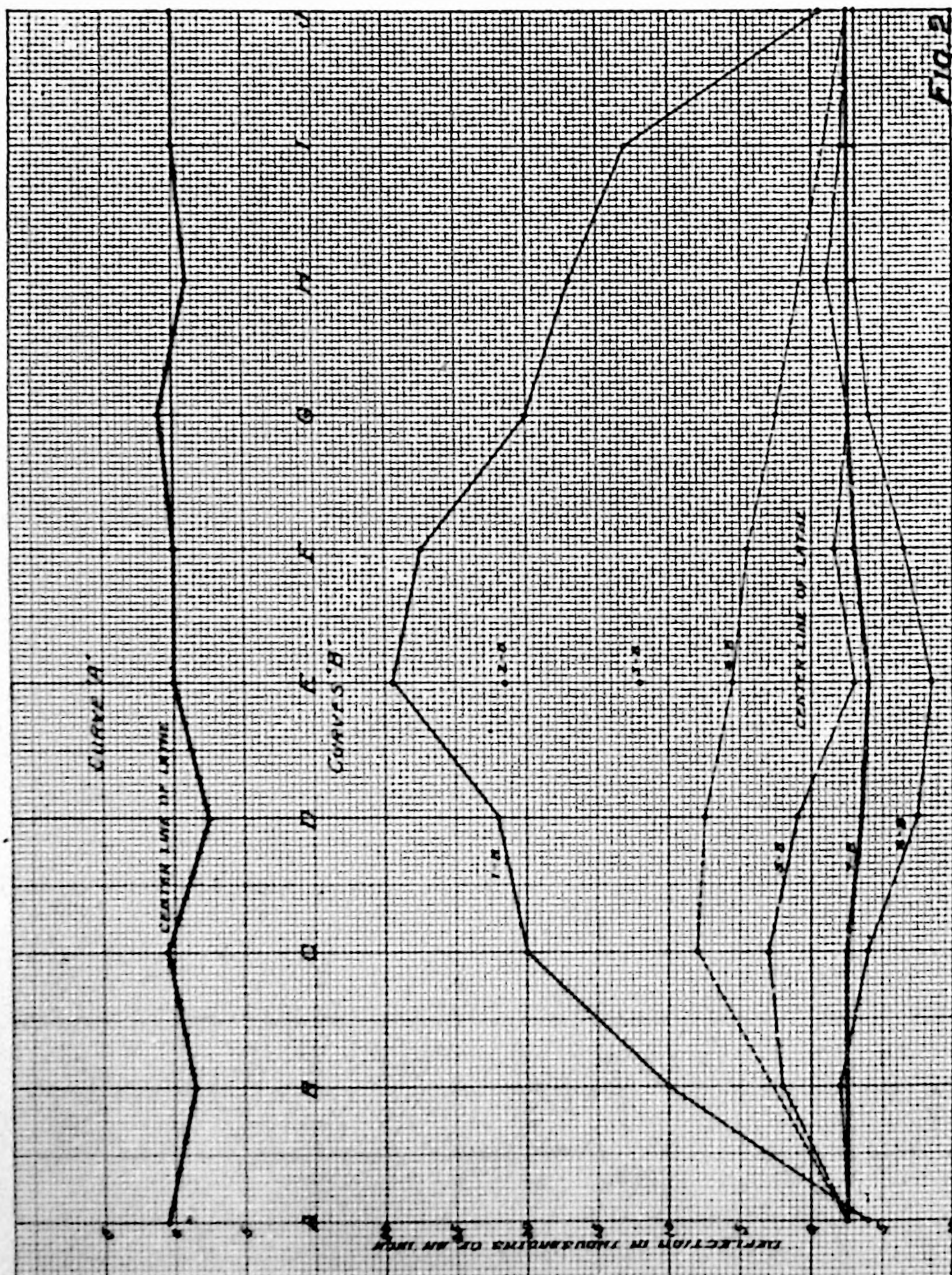
The curves in Fig 2, show the shaft indications before the heat treatments, and the progress of the different treatments, Curve A shows the center line of the shaft, in a plane passed through point 1-5, Fig. 1. An inspection of this curve shows that the shaft was accurately chucked at end J, but the shaft center at end A was out of true one-half of one thousandths of an inch. The maximum deflection was approximately two and one-half thousandths of an inch at point D. The shaft in this plane was sufficiently near perfect for all practical purposes.

Curve 1-B, Fig. 2, shows center line of the shaft in a plane passed through points 3-7, Fig. 1. This curve shows the center line of the shaft at J was out of true with the center line of the lathe one-half of one thousandth of an inch, and at end A four thousandths of an inch. The maximum deflection at point E referred to the lathe center was a total of twenty-nine and one-half thousandths of an inch; allowing for the amount that the center line of shaft was out of true with the center line of the lathe, total deflection at point E was thirty-two thousandths of an inch.

The shaft was now supported in the lathe with a plane through points 3-7, Fig. 1. vertical and the point 3 at top,—this point being on the convex side of the shaft. A steady rest was now placed at point C, and brought up snug against the shaft, and the tail stock backed away, so that the end A was free to move.



The lower part and also both sides of the shaft at the point of maximum bend was packed with asbestos, fire brick, other heat resisting materials, and in some instances, ice, so that the top of the shaft for a space approximately eight (8) inches in



width and thirty (30) inches in length was exposed for the heat application.

Heat was applied with two large kerosene torches, capable of producing intense heat, this heat application lasting for a period of eight minutes. The top of the shaft expanded, increasing the amount it was out of line, causing the end A to be deflected downward three hundred and seventy-five thousandths of an inch.

This heat application was made on the morning of March 26th, and the shaft was then allowed to cool until the following morning when end A was again supported with the tail stock center and the steady rest backed away from the shaft. The shaft was now indicated and while complete details of the results of the first heat treatment were not recorded, the shaft at E now showed a maximum deflection of only twenty-one and one-half thousandths of an inch, which is shown at point 2-B, Fig. 2.

This process was repeated with the result that the second heat treatment, brought the centre line of shaft at point of maximum bend down to point 3-B, Fig. 2.

The results of the third treatment were recorded more in detail and are shown on curve 4-B, Fig. 2, which shows that each treatment is gradually straightening the shaft.

The fourth treatment was applied at point D, with the result of the treatment shown in curve 5-B, Fig. 2.

The fifth treatment was applied at point between B and C, the results being shown in curve 6-B.

It will be noted that the successive treatments have carried the center line of the shaft on beyond a straight line, so that the convex side is on the opposite side from that of the start of the treatments.

The sixth treatment was applied at E, the results being shown in curve 7-B, Fig. 2. Allowing for the amount that the center line of the shaft is out of true with the center line of the lathe, the shaft now shows a maximum deflection of only one and one-half thousandths of an inch.

At this time the shaft was again indicated for deflection in a plane passed through points 1-5, Fig. 1, and while no records were made of these results, it was found to be as accurate as the center line of the shaft in a plane passed through points 3-7, which is shown on curve 7-B, Fig. 2. It would hardly be possible to make a new shaft that would be more accurate and no attempt was made to remove the few remaining inaccuracies after the sixth heat treatment.

The length of time of all heat applications varied from five to eight minutes, the shorter time being used as the shaft approached a perfect line. Subsequent straightening of the shaft of a similar but smaller turbo-generator in Georgia, which work was done under the directions of the same representative of the General Electric Company as the straightening process described in this paper has shown the importance of being able to apply the heat with an intense flame quickly so that the convex side of the shaft would be brought to a comparatively high temperature and this side of the shaft expand before the heat was transmitted to the concave side of the shaft. In the work done in Georgia, large kerosene torches were not available and with the inadequate means for heating at hand, the straightening process proceeded very slowly.

Before the writer agreed to present this paper, he made a preliminary investigation and was of the opinion that data from recognized works on metallurgy could be presented that would show the reasons for the change in the steel structure under the comparatively low temperatures. Later, after more complete investigation, it was found that this preliminary analysis was in error and could not be followed to a definite conclusion with the low temperatures. This phase was taken up with the General Electric Company, and they stated that no investigation had been made to ascertain the cause of the results obtained with the heat treatment. It had been observed that when shafts had been sprung from heavy rubbing against diaphragms or wheel case head packing that the point where the heaviest rubbing occurred was always on the concave side of the shaft. It was therefore deduced that if heavy rubbing on one side of a shaft would cause it to heat and spring that the application of heat on the other side would bring the shaft back straight.

After this turbo-generator unit was reassembled and the revolving field and bucket wheels rebalanced, and the machine placed in service carrying its full rated load, there was practically no vibration. This unit is not as economical as units installed later and is now only used for yearly peak load periods or in the event of accidents to the larger units in this generating station. The fact that work was completed some nine or ten months ago and that today this unit operates satisfactorily with no vibration indicates that this straightening process must be permanent.

ROAD FINANCING.

By Hon. Harry E. Gamble.

An address delivered before the Louisiana Engineering Society, March 14, 1921.

Road financing as well as road making has passed through different phases as well as road construction in different periods of the world's history. In ancient times roads were constructed, where they were constructed at all, by governments for military purposes. Such were the roads constructed by Rome when she was mistress of the world. Other than these military roads, there was not in ancient times any such thing as a system of roads. Animal trails grew by use into whatever roads there were. Through the dark ages and middle ages roads have no history. By the beginning of the 18th century, men began to agitate for better means of travel and transportation. Macauley tells us that in the 18th century roads could not be worse than they were between some of the most prosperous towns and cities of England.

Improvement began by letting out road building, and capitalists who built with their own capital obtained from the government the privilege to charge tolls over the improved highway. The toll road plan resulted in much improved highways in France, Britian, and in some portions of the United States in the early history of this country. In this country during the last century, the idea of road construction by government, that is, to say under governmental supervision, from funds derived by property taxation, either special or general, grew to a considerable degree; always retaining, however, as a base the proposition that those living adjacent to the highway should bear the cost. Hence we see that road cost has been borne

1. By ancient governments, principally for military purposes.

2. At a later time by private capital, with the right to charge for passage, which meant, of course, the cost paid by those using the road.

3. At a still later time, and up to now, by a general tax levy in a specified districts, with sometimes a special assessment on property immediately adjacent to the road; which is the public improvement idea, that is that tax payers get a return for their money in the general benefit of good roads. Along with this method is developing in the last ten years the vehicular tax, which carries the idea that those who use the roads should contribute to their construction, thus returning to the toll idea.

From an examination of the methods of providing the cost of highway construction now in vogue all over the United States, it is plain that no single principle governs; and that often habit, necessity, and expediency control equity. In some places the habit of voting an advolorem or general property tax continues without much question as to whether it is a just distribution of the burden of road construction. In others the amount of property, population, and other factors, make it expedient to follow one course or another without inquiring too strictly whether the method of raising money is even reasonably just.

Considering our own situation here in Louisiana, and before we investigate the practice of other sections, let us, if we can, inquire what are the principles which should govern in raising funds for road construction. What is and what is not a governmental function changes with different theories of government, and in different ages. Without going into these theories, we may say that with us to maintain peace and order, administer justice, to provide for public defense, and public education are admittedly governmental functions and are performed at public cost out of funds derived almost exclusively from general taxation on property. To open and improve channels of transportation and communication is certainly a great public benefit extending to all. Yet the fact that the telephone, telegraph, and railways, city and country, are constructed at private expense and paid for by those who use them, show that providing communication and transportation is not regarded as a governmental function. It is true that the government operates a good many public utilities, and particularly abroad; but the users of these utilities pay for them. They are not supported from general taxation. Public taxation is in the early history of the United States and in the more recent history of this State has been used to help construct railways, but always under a special condition, such as building through sparsely settled territory, or from a special advantage supposed to be derived by attaching a particular town or community. Such taxes are not now the fashion. The special benefit derived by special persons and classes are so much more than the general benefit, that it is considered fair and just that those receiving these benefits should bear the costs. On the same principle it can not be admitted that it is a governmental function to provide the cost of highway construction out of general taxation. I think it can be set down as a fair principle, then, that the cost of highway construction should be borne by those who benefit by the construction. Those who benefit by the construction are:

1. Those who travel on it and transport commodities over it.
2. Those who own property immediately adjacent to it.
3. The general public in the sense that any improvement is a benefit to the state.

It is obvious that the greatest benefit is to those who use the highway, and next, to those whose property may be made more desirable from being on or near to the highway (notwithstanding their taxes are raised by the enhancement in value.) The general benefit is more remote and speculative.

Notwithstanding this undeniably fair and just principle, it has not always been perceived, nor even if perceived, was it, nor could it always have been the sole guide. Necessity, expediency and even mere habit, all have contributed under varying conditions to violate the principle, and force the construction of roads in many cases by a general or a special property tax.

The theory that the local tax payer should bear the cost, was much supported also by the idea that he was the main user of the road, since under former conditions of travel and the kind of vehicles in use he was in fact the principal if not the only user of the road. Of late years, however, the enormously increased use of highways on account of motor vehicles, when a day's travel by motor covers nearly ten times the distance formerly made by horse power, has done a great deal toward removing the idea that roads are for local use and benefit alone. With increased comfort and speed in travel, naturally comes increased use with increased cost for construction and upkeep.

These considerations induce us to re-examine the whole question. When we do, I have doubt that we will adopt the general principle that those who use the roads must not maintain them, but must construct them, with aid in construction from classes who benefit in proportion to the benefit;—the general principle to be varied whenever expediency and necessity require. It must be remembered that we are now speaking of a state system, and that in planning a project for financing a state system, it must be kept in mind that there is, and must always be, a very heavy property tax to keep up necessary local roads that do not constitute a part of the state system.

Now we come to fixing the cost of trunk lines between those who benefit from them. There can be no such thing as an exact measure of such benefit. An arbitrary division based on a general view would suggest that at the very outside one-third of the cost might be raised from a general property tax, and two-thirds from a motor or vehicular tax in whatever form applied. This places a rather disproportionate share of the cost of construction of a state system on the property owner who, when his property is more than three or four miles from the road, or in a city, is certainly far less benefitted than adjacent land holders and travelers. It is the sense of the community, however, that road building is that kind of public improvement which enhances the value of all property, and makes life generally more endurable; and, considered from that viewpoint, perhaps a one-third contribution by property taxation to the construction of a state system would not be inequitable, especially if the whole burden of maintenance hereafter be placed upon road users.

It is proposed by some that we raise for road construction several millions, varying according to the plan from twenty-five to thirty, by bonding a general property tax, and levying a motor tax later on for maintenance purposes. Some others who oppose borrowing money are in favor of levying a heavier annual property tax so that the income will be sufficient for any necessary expenditure. It is agreed between them that property tax payers should bear the cost of road construction at the rate of 1½ mills per year to four mills; they differ only in the amount it will be expedient and economical to spend annually.

Whether we should anticipate revenues and expend so much per year more or less is a secondary question. We must depend upon a combination of facts such as availability and cost and labor and materials, experienced contractors, etc. This is a question much more easily solved than determining who is going to put up the money, for, if labor, material and experienced supervision is not available in the first year or two, we could lay a plan which could expand to our needs. Certainly it would be unwise in the present state of industry, transportation and labor to lay down rigidly an ambitious scheme of large expenditure when it appears certain that the very extent of the plain would in the beginning increase our difficulties and cost. I say again that the question of what sum shall be raised per year, therefore, whether we shall have to anticipate revenues by bond issues, is a secondary question.

Returning to the principal question, who must bear the burden of trunk line road construction, the plan of laying it on the property owner is inequitable, inexpedient and impossible. It is inequitable for the reason that those who get the most benefit contribute nothing, that is, those who use the roads for travel and transportation. It is inexpedient because property taxes are as high now as they can get, and yet more money must be raised for education and local roads. Lastly, it is impossible; the people are not going to endorse it, and the Constitutional Convention will not dare to lay a heavy property tax without submitting it.

The motor manufacturers, salesman, and some owners seem to imagine that they are liberal to propose to maintain an expensive state road system which the property owner ought to build for them. We owe a debt to motorists, notwithstanding their private and personal interest in road construction, for this very interest drives them to agitate in season and out of season for road improvement. They maintain organizations and bureaus that make much research and gather valuable and instructive data. But they should be on guard against bias in their own favor. Their is a flavor of childish innocence, quite honest I do believe in their proposition that someone should build them a road. Right here it is well to remove a common fallacy in regard to motor taxes. Motor vehicles pay a property tax, parish and state, varying from $5.00 to as high as $75.00. Perhaps one's natural inclination is to demand that the taxes from his motor vehicles should be applied to the roads. This is founded upon no just claim. He is merely a property tax payer as is the owner of a house and or farm, and has no more right to demand that the property tax upon his property should go upon the roads for his use, than the house or farm owner has a right to demand that his property tax be applied in whole or in part to the improvement of his property. The car owner, as a property tax payer, is therefore no different from any other property tax payer. Let us take a very common illustration: One man pays taxes on his car. Another pays taxes on his car and a ten thousand dollar farm or home. Are the benefits to the second as a property owner sufficiently great to authorize placing upon him the entire burden of constructing a road for the use of both? Certainly not. They should both pay according to their use of the utility, and then the property owner should add something for the benefit he derives directly or remotely as a property owner.

Let us consider the matter from another point of view: Speaking by averages, the wear and tear upon a motor vehicle will cost the owner $250.00 per year for his car; he pays $150.00 a year for power to drive it, a total of $400.00. His average license tax now is $7.00, which, if applied to roads, would result that a car owner is willing to pay $400.00 per year for vehicle and power, but not more than $7.00 a year for a place upon which to drive. The disproportion is altogether too great. The motor owner can certainly stand a considerably higher contribution in order to have the full and economical use of his vehicle and power. In any event, it is not well for him to undertake to thrust the burden of building his roads upon another, when his benefits are so obvious.

For the year 1920, the property valuation of all automobiles listed in the State of Louisiana was, in round figures, thirty seven million dollars. The number of mills tax as an average for the entire State would be less than thirty mills. At thirty mills this would give $1,110,000.00 as the amount of property taxes paid upon automobiles in Louisiana annually. Calculated on the assessment valuations of 1920 for the State, which amounted to seventeen hundred million dollars, the amount paid on automobiles equals to about 2/3 of one mill on the whole. It is obvious then, that if the automobile property tax were remitted altogether, it would be equal to a remission of two-thirds of one mill tax upon the entire property of the State; or, stated in another way, to remit the property tax on motors, would be a contribution from the entire property tax payers of the State of two-thirds of one mill on other property If the present property tax on motors were converted into a vehicular tax, by license or gasoline, or both, it would amount on an average to $15.00 per car. If then, the motorist would contribute a further sum of twice this amount, making a total average tax of $45.00 per year, it would result that the property tax payer would contribute one-third of the cost of the state road system (by the remission above referred to) and the motorists two-thirds. This tax would raise more than three million dollars per year, and if considered too heavy or raising too much money annually, it could be reduced and bonded, provided, of course, the proportions were maintained.

I earnestly recommend to the motor interests that they get behind a proposition of this kind. It will be impossible for them to put the whole cost of road construction of a state system upon the property tax payer; to obtain the one-third contribution above suggested will require the most diligent cooperative effort.

Although this paper deals with the question of road financing, I wish further to add on the question of construction, that Louisiana is not yet ready to build the so-called permanent road, costing from thirty to fifty thousand dollars per mile. When it is said that the gravel road is a failure that simply means that it is not maintained. If maintained at standard at a cost of about $500.00 per mile per year, it will be a sufficient road for our needs until we grow more wealthy and populous. In any event, such roads are only built in the wealthiest and most populous communities in the East and West, and it is out of the question for us to discuss them now.

DISCUSSION.

Mr. Coleman: I did not come to discuss the paper tonight. I came to be instructed. Most certainly I would not want to cross swords in the legal phases of the case with Mr. Gamble. There are, however, two or three of his statements with which I am not in accord and I would like to call attention to them.

In the first place Mr. Gamble bases his conclusion largely upon the fact, or theory, that road building is not a governmental function; that transportation is not a governmental function, which conclusion he deduces for the reason that in the United States the telephone, telegraph and railroad lines are not built and operated by the United States government, although they have been aided by the government in times gone by. It is a fact, however, that another very important transportation agency in the United States, that of water transporation, has received very material aid at the hands of the United States government. It is also a fact, I believe, that in a very large number of the other governments of the world the transportation agencies are wholly governmental agencies; and these other governments may be right, and we may be wrong. So I do not think it may be stated as a definitely proved fact that the building of roads is not a governmental function. Certainly it is not proved to my satisfaction by the mere fact that the government of the United States has not built our railroads and telegraph and telephone lines. I cannot admit that this is a demonstration of the fact that the construction of highways is not a proper governmental function.

Now as to the other proposition, that those who use should pay:

As a matter of common equity, this is true; but as a matter of practical value it cannot be made true in anything that we do. We bind ourselves together in a community, such as for example, the city of New Orleans; we then desire certain specific utilities such as water works, sewers, drainage, etc., and we find ourselves taxed to accomplish this character of service. Now in the city of New Orleans, the man who lives at

Chef Menteur pays the same property tax to accomplish this purpose out of the general fund as the citizen who lives at St. Charles and Napoleon avenues pays.

Mr. Gambee: He pays for the use of it.

Mr. Coleman: He does not get any use of it. He has no sewer within twenty miles; he has no drainage; no policemen, except nominal police protection; he has few benefits such as those of us who live in the developed part of the city enjoy. These things were necessary for the community in general and we had to procure them by taxation of the public, the people of the city, as a whole. It is unfair to the resident of Chef Menteur; and in proportion, it is just as unfair perhaps to the resident of St. Charles and Napoleon Avenues. But it illustrates, the fact that no law can work with equal justice to all men, from a finite point of view. Even the law of God works individual hardships on those who are ignorant of its penalties. God says that fire burns, and ignorance does not excuse one from its penalties, or change the operation of the law. The child sticks its hand in the fire and it burns. It seems a hardship that the innocent child should burn its hand. So if the laws of God work hardships, we may not expect better results from man-made laws.

I have no plan to offer for the financing of highways. I think we may assume that we are unanimous in the conclusion that we need the highways; and that that system which most equitably distributes the costs will be the most satisfactory system. I do not think it would be fair to make the car owners pay an undue proportion, any more than it would be to make the farmer in a remotes region of the state pay an undue proportion. As a motor user myself, I would be perfectly willing to pay forty-five dollars, or even a hundred dollars, toward a fund as outlined; I would feel that I got my money's worth as a citizen of Louisiana. If I was not a motor car owner, I would also be willing to contribute one hundred dollars a year for a practical and usable highway system, and would feel as a citizen of the state I got my hundred dollars value from properly built highways.

Mr. Gamble spoke about the proposed highway, that it was not so necessary in these days as it would have been in the pre-railroad days; that the producers were now able to get their goods to market on the railroads. Well, I have rambled about the state nearly as much as Mr. Gamble has, and I know a great deal of it very intimately, both physically and the people who live in it; and I know that the residents of the great proportion of our state—not in the large communities but in the country—suffer quite considerably in bad weather from their inability to transport their goods from their farms and plantations to the railroad; frequently they are hung up for days at a time from their inability to transport these goods.

In this connection, I recently happened to visit one section of the state where the distance to the closest railroad was something like nine and a half or ten miles, and where a very considerable piece of construction work has been going on for a period of eighteen months. I have forgotten the exact figures per ton, but I will say that it was enormously expensive to haul material for that particular work. In order to reach the nearest railroad point from this piece of construction we had to travel about ten miles on a road which after half a day's rain following a long drought was almost impossible to travel with anything but a horse drawn vehicle.

Now, while of course motor car owners would benefit by building a highway there, they would not be the only beneficiaries because the entire length of this road was dotted with houses and there were many side roads leading into it along its route.

Now, in conclusion, I will say that I am perfectly willing to consider any way for financing highway construction in the State of Louisiana, in no matter what form it comes; and I will feel that provided the money which is paid into the State for highway construction is honestly and intelligently disbursed in the construction of highways, that I will surely have gotten my money's worth.

Mr. Lawes: There is one question I would like to ask: Mr. Gamble says the tax amounts to forty-five dollars. You will just use that forty-five dollars for a road tax, and then no other tax on the car?

Mr. Gamble: My idea involves the idea of deducting your property tax, which means that the people, the state and the parishes, must make it good by an additional property tax, and the payment of taxes received from motors must go on the construction of roads.

Mr. Lawes: If that is the case, it would not be any hardship on the motor car owner, because he would pay the tax anyway.

Mr. Malochee: Is there not a tax to the owners of vehicles other than a motor tax now?

Mr. Gamble: Oh, yes, you pay a small property tax.

Mr. Malochee: A small property tax! I certainly believe, as one of those here who is not a car owner, that the proposition of Mr. Gamble is more than clearly equitable to those of us who are paying taxes and who may not have to use the roads. Now, for instance, there is a man living here in New Orleans who never travels. Why should he pay enough to contribute to the maintenance of the roads and the system of roadways throughout the state?

Mr. Coleman, in a very Eutopian and chivalrous way, stated that if he was not a car owner he would be willing to pay a hundred dollars a year for the maintenance of these roads, or the building of these roads. I believe my self it would be a very nice thing indeed for those who are going to use the roads. But for the men who are not car owners, they are like our friend at Chef Menteur, who is paying an unjust tax and who is paying it simply by force of numbers in New Orleans; he was put up against the wall and shot at and had to accept it; there is no question about that.

But I do believe that a man who is going to use a utility should pay for its construction, and certainly should pay for its maintenance. And unless any system that is proposed in financing includes some method of maintaining these roads, and that these roads be constructed, not of shell or like material, but of permanent material, I personally would be against any tax against anybody, be he motor owner or property owner. I believe Mr. Coleman has put that in another way: "Honestly disbursed and properly built." But I go farther and say that outside of the actual building, from the time they are built something should be done in the matter of maintaining them. The roads may be good roads at the time of building them, but being left to themselves with no proper maintenance they soon deteriorate and become bad roads.

Mr. Barelli: Mr. President, I think the property owner should be taxed also. We run a road through property that is assessed at five dollars an acre. Perhaps that property jumps up to a hundred or two hundred dollars an acre, of course depending on its locality; but as long as we did not have the road that property still remained assessed at five dollars an acre. Now that property owner is certainly entitled to pay his proportion of the cost of that road, because this materially increases the valuation of his property.

I don't think the whole tax should be imposed upon the automobile owner. What is going to build up our state? Good roads. It is going to bring people here. It is going to bring people here from every part of the country. They will improve the property through which the good roads are run.

It is true, the automobile owner rides over it occasionally, but he does not get all the benefit out of it, and to pay a property tax of one-third is a very small proportion in my estimation.

Mr. Robert: I just want to say a word or two in reference to one phase of this question.

In the north and east, where there is a greater density of population than down here, good roads have still another significance, because it has been demonstrated time and time again that the economical limit of a haul is two hundred miles. That is to say, it is equally expensive to ship by motor truck up to two hundred miles, but that it is cheaper on short hauls to ship by motor truck than by railroad.

You can see very readily that this means that an abundance of good roads are necessary close to large communities; and that being true, it is perfectly plausible and also true, that those good roads add to the cheapness of living in those large communities.

Now, you take a person who lives in New Orleans: Suppose he owns no land; suppose he owns no property in the city; suppose he owns no motor. Somebody says he cannot see why that man is interested in a good road. But he is, because supplies which are brought to him from the outside can be shipped more cheaply by motor truck than by railroad, and then the cost of living for that man is going down while he lives in this community, even if he does not own five cents worth of property. That man, I claim, is interested in good roads, more or less, because his living is made less expensive by good roads. I believe thot is an argument for good roads all over the country.

In discussing good roads, let us not forget that the economical benefit of good roads does not come from a few people riding over them Sunday afternoon. If that is all they are good for then property would not be benefited by their construction. One of the principal purposes of good roads is for the transportation of commodities. If they are not used extensively for this purpose, it is almost useless to build them. The railroads are congested; capital is not available for increasing their facilities. The handling of commodities over good roads is certainly a most important phase of the question, and one which is shared by every person in the community, whether he be an owner of an automobile or not.

Mr. Gamble: Just a few words about whether road construction is a governmental function, in reply to Mr. Coleman, who illustrates building the gas system and the water system and the drainage system in the United States, and the road system as they do in Europe.

You must not forget that it is not the government who built and paid for your transportation over there. The government in many cases operates the transportation system, but always travelers pay for its use. In other words, it is the users of them who built the roads. It is applying the toll system, the toll principle. When the capitalist built a toll road he built it out of a private fund, but in the long run those who used the road, paid toll over that road, paid for the road.

Now, in closing, I want to say as I said in the beginning, that necessity often controls us in carrying out the equitable principle, and in this state, has required us to build most of the roads that we have built out of the general property tax fund.

I make the statement, however, and I believe it cannot be successfully contradicted, that the tendency in other states of the union is to not only maintain by motor tax but to construct by motor tax. Out of about thirty-six states which I have had communications with lately, I find that sixteen of those states are constructing by motor tax, as well as maintaining by motor tax.

For instance, Alabama issued twenty-five million dollars' worth of bonds lately on the proposition of retiring them wholly by motor tax. Michigan issued fifty million dollars worth of bonds. Illinois sixty million dollars worth of bonds, based wholly on the proposition of having them retired from motor taxes; and North Carolina fifty million dollars worth.

Mr. Coleman: Was not the Alabama issue overruled by the Supreme Court?

Mr. Gamble: It was: but not the question of whether the people of that state thought it should be raised by a motor tax. They expressed themselves in favor of a bond issue; but through some technical error or something that I have not been informed of, the bonds issue was held unconstitutional; but that fact does not get us away from the fact that the state of Alabama was in favor of a twenty-five million dollar bond issue based on their retirement from motor taxes.

Now, as both Mr. Coleman and some other gentleman have said, it is totally impossible in government to treat all men justly; it would be totally impossible if you were going to raise funds. The ideal way would be that a certain proportion would be paid by the user of the road, the motor owner, and a certain proportion by him whose property is immediately adjacent to the road, and in a smaller way those who are more distant, and who gradually and by gradations are benefitted. But those things, of course, are impracticable in legislation; impracticable in our administration of human affairs. Naturally some must bear burdens more than others.

But it occurs to me that to put one-third of the cost on the taxpayers of the state is the most we can demand from the property owner.

In connection with the technical or legal side, I will be glad to answer any other question you may wish to ask.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Board of Direction, January 8, 1921.

The meeting was called to order with President Riess in the chair and the following present: Messrs. Manley, Barelli, Lawes, Robert.

Ballots for new members were opened, there being 73 cast, and as a result the following were elected to the respective grades of membership in the Society:

Resident—Joseph P. Borges, Leo S. Weil.

Non-Resident—Julian D. Monette.

Associate—Lewis McC. Dalgarn, James W. Spence.

There being no further business, the meeting adjourned.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Society, January 8, 1921.

The regular meeting of the Society was called to order with President Riess in the chair and 40 members and guests present. The minutes of the previous meeting were read and approved.

The annual reports of the Secretary and Treasurer were read and ordered published in the Proceedings of the Society.

Ballots for officers for the ensuing year were then opened, there being 95 ballots cast of which 90 were regular and 5 irregular. As a result the following were elected for the year 1921:

President	Rufus S. Manley
Vice-President	Donald Derickson
Secretary	James M. Robert
Treasurer	Walter B. Moses
Director, for Three Years	Bernard S. Nelson

The new president having been escorted to the chair, the meeting was adjourned to Francois' Restaurant for the Annual Smoker.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Board of Direction, February 14, 1921.

The meeting was called to order with President Manley in the chair and the following present: Messrs. Barelli, Derickson, Riess, Lawes, Nelson and Robert. Minutes of the previous meeting were read and approved.

The application of Mr. Robert Fagot for reinstatement was granted, Mr. Fagot having paid his arrears. Upon motion duly seconded, the following resignations from the Society were accepted as of January 1, 1921: Thomas L. Willis, Resident Member; Lee A. Christy and A. Rogers Mielly, Non-Resident Members; C. G. Lowe and J. M. Van de Veer, Associate Members.

The bill for the First Quarter dues for the Federated American Engineering Societies was ordered paid.

A letter from the American Association of Engineers inviting us to send delegates to their meeting in Chicago on February 25th, was read and the Secretary instructed to thank them for their kind invitation.

A letter from the American Society of Mechanical Engineers donating $25.00 to our Society for each meeting held under the auspices of the A. S. M. E. was read and the Secretary was instructed to accept with thanks.

A letter from the local section of the A. S. M. E. extending an invitation to all members of the Society who wish to attend the joint meeting of the Birmingham, Atlanta and New Orleans sections in Mobile on April 22nd., was read and upon motion duly seconded, the Secretary was instructed to send copies of this letter to our membership and urge attendance.

The report of the Secretary was read and approved and bills ordered paid. There being no further business to come before the meeting, the same was adjourned.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Society, February 16, 1921.

The meeting was called to order with President Manley in the chair and 66 members and guests present.

A letter from the Louisiana Section, American Society of Mechanical Engineers concerning a coming joint meeting of the New Orleans, Birmingham and Atlanta sections in Mobile, April 22nd., was read to the meeting and the Secretary was instructed to communicate with the membership concerning this meeting. It was the sense of those present that every effort should be made by the membership of the Louisiana Engineering Society to attend this joint meeting.

Col. Marcel Garsaud made a short statement to the meeting upon reciprocity between ourselves and other states concerning the State License laws.

Mr. J. F. Coleman extended an oral invitation to the members of this Society to attend the meeting of the American Society of Civil Engineers in Houston in the near future and Mr. Coleman's invitation was accepted with thanks.

The technical exercises of the evening were then proceeded with and Mr. Frank G. Frost of the N. O. Railway and Light Company read an interesting paper entitled, "Straightening a Large Shaft by the Heat Process." This was followed by a talk illustrated with moving pictures, by Mr. Griess, of the McMyler-Interstate Company, of Cleveland, Ohio, on "Cranes." The exercises were very interesting and thoroughly enjoyed by all present.

There being no further busines to come before the meeting, the same was adjourned to the usual collation.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Board of Direction, March 14, 1921.

The regular meeting of the Board of Direction was called to order with Vice-President Derickson in the chair and Messrs. Lawes, Barelli, Moses and Robert present.

A letter from Major A. M. Shaw, was read suggesting that one meeting per year of the Louisiana Engineering Society be held under the auspices of the Louisiana Section of the Society of American Military Engineers. This local section has just been organized upon a permanent basis here. Upon motion duly seconded, the Secretary was instructed to notify Major Shaw that the Louisiana Engineering Society will be glad to hold one meeting a year under the auspices of the Louisiana Section of the Society of American Military Engineers, as outlined.

The following applications were approved and ordered through the ballot for the respective grades of membership:

Resident Members—Charles C .Crawford, Eugene N. Ehrhart, Allen S. Hackett, Ector Brooks Latham, Walter E. Winship.

Transfer from Junior to Resident—Eugene M. Hornot.

Non-Resident—Waddy Thompson Drew, Roger Irving Tanner.

Associate—Howard Harrington Marsh.

Student—Simon Bernard Schwartz.

Upon motion duly seconded, Mr. Walter Moses was given authorization to withdraw the funds of the Society from the Whitney Central Bank and to deposit them in some other bank, notification to be made to the Board of Direction of the name of the bank in which said funds are deposited.

The report of the Secretary was read and approved and bills ordered paid.

A communication from Major Shaw was read in which he advocated the removal of the Library from the present location to some more centralized location in the business part of town. Upon motion duly seconded, the Secretary was asked to write Major Shaw and ask him to investigate the matter particularly as to location, removal cost and cost of equipment and to report at the April meeting of the Board.

There being no further business, the meeting adjourned.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Society, March 14, 1921.

The regular meeting of the Society was called to order with Vice-President Derickson in the chair and 45 members and guests present. The minutes of the previous meeting were read and approved.

Mr. J. F. Coleman made a statement concerning a meeting of the American Society of Civil Engineers in Houston. Upon motion duly seconded, the President was authorized to appoint a committee from this Society to entertain such members of the American Society of Civil Engineers as would pass through New Orleans on their way to Houston.

The technical exercises of the evening were then proceeded with and the Honorable Harry P. Gamble lead a most interesting discussion entitled, "The Financing of Road Construction," after which a rising vote of thanks was tendered Mr. Gamble and the meeting adjourned to the usual collation. JAMES M. ROBERT, Secretary.

The Proceedings of the
Louisiana Engineering Society

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DOUGLAS ANDERSON, Editor.

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LOUISIANA ENGINEERING SOCIETY

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Vice-President, DONALD DERICKSON, Tulane University.
Secretary, J. M. ROBERT, Tulane University.
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The headquarters of the Society are in the State Museum Building, Jackson Square.

All business communications should be addressed to J. M. Robert, Secretary, P. O. Station 20, New Orleans, La.

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

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CONTENTS

EDITORIAL NOTES AND COMMENT: PAGE

Forest Conservation in Louisiana ... 111
Federal Aid in the Construction of Public Roads ... 112
Elimination of Waste in Industry ... 113
Some Facts About the Telephone ... 113
New Members ... 114

PAPERS AND DISCUSSIONS:

Why Louisiana Conserves Her Forests,
By R. D. Forbes ... 115
Federal Aid in the Construction of Public Roads,
By Henry B. Cooley ... 123
Waste in Industrial Processes,
Issued by The American Engineering Council ... 133

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY ... 141

EDITORIAL NOTES AND COMMENT

Forest Conservation in Louisiana. The history of the lumber industry in the United States in so far as any altruistic feeling or any consideration for the welfare of future generations was concerned has in the past years been characterized by a spirit of selfish commercialism, in which the rights of the general public have been treated in somewhat the same spirit that animated the railways in their one-time slogan "The Public Be Damned."

And when the subject of Forest Conservation in Louisiana is broached one's thoughts rather automatically turn to the proverbial snakes in Ireland. It is of interest to note, therefore, that the subject of Mr. Forbes' paper is "Why Louisiana Conserves Her Forests," and while he does not go into the statistics of the present status of the forest conservation in the state, he does give an interesting discussion of the most potent reasons why our forests should be conserved.

A survey made in 1919 by the Southern Pine Association discloses the somewhat startling fact that of the 301 mills cutting pine in Louisiana in that year, only 32, or about 10%, had enough standing timber to last them beyond the year 1929.

To replace these vanishing supplies by bringing timber from the Pacific Coast means the addition to the already high price of lumber the sum of about $28.00 per thousand to cover the long haul of 2500 miles from the mills of Oregon and Washington.

Louisiana's "cut-over" lands lend themselves more economically and more logically to the reforestation than to either farming or grazing lands; but the fact is that there is no pressing need for using the lands for agricultural purposes. Only about 50% of the present available agricultural lands are now improved and under cultivation.

Mr. Forbes makes the significant statement that it is better to grow trees than taxes. Pine land which before cutting was assessed at an average of $48.00 per acre for taxation purposes is worth only about $6.00 an acre as cut-over land. Denuded cypress land has a value of less than 4% of its former value. Hardwood land, when the timber is removed, decreases in value by 50%.

The re-growth of timber in Louisiana is very rapid. Wood for paper pulp can be produced in 15 years; cross-ties, piling and telephone poles in 25 years; and good lumber in 25 to 40 years.

Federal Aid in the Construction of Public Roads. Under this title we are publishing in this issue a paper written by Mr. Henry B. Cooley, a member of the graduating class in Civil Engineering of the College of Engineering, Tulane University.

The writing of this paper was undertaken as a piece of assigned work in the department, and Professor Derickson was so impressed by the excellent quality of it that he offered the paper for publication in the *Proceedings*. Of course Mr. Cooley makes no claim to first hand information on the subject, but a perusal of his paper will show that he has pretty thoroughly digested the available sources of information and has then been enabled to compile in short compass a very excellent resume of the subject. He begs to acknowledge his indebtedness to the various publications of the Bureau of Public Roads, and in particular to a paper by Mr. Thomas H. MacDonald, Chief of the Bureau of Public Roads, entitled "Four Years of Road Building Under the Federal Aid Act."

Mr. Cooley's article will serve also as a supplementary discussion of Mr. Gamble's address on Road Financing, published in the April issue of the *Proceedings*.

Elimination of Waste in Industry. Published elsewhere in this issue of the *Proceedings* is a brief abstract of a report on this subject, made by a committee appointed by Mr. Herbert Hoover. This report is the first work undertaken by the Federated American Engineering Societies, and is the beginning of a movement on the part of some 200,000 organized engineers to bring about better industrial conditions and more harmonious relations between capital and labor.

Some Facts About the Telephone. In a very interesting little booklet issued recently by the American Telephone and Telegraph Company some data about the telephone are given which are of rather striking interest. The telephone is such an indispensable part of our everyday life that it may be difficult for some of us to realize that as an invention it is only forty-six years old.

Alexander Graham Bell made the discovery of the principles of the phone on June 2, 1875.

October 9, 1876, Dr. Bell talked from Boston to his associate, Thomas Watson, in Cambridge, a distance of two miles, and was highly elated over the success of the test.

It is of historic interest to note that on January 25, 1915, Dr. Bell, in New York, talked to the same Thomas Watson, in San Francisco, over a line 3400 miles long. A part of the time he used a telephone which was an exact model of the first one made, showing that the increase in range was a matter more of the lines and auxiliary apparatus than of the telephone itself.

On January 1, 1877, there were 2593 telephones in use throughout the whole country.

Today there are over 13,000,000 in the United States alone, two-thirds of all the telephones in the world.

New Members. Since our last issue the following elections to membership and transfer have been made:

Resident Members—Joseph B. Converse, with J. W. Billingsley, Consulting Engineer; Daniel S. Elliott, Professor of Physics, Tulane University; Herbert M. Gallagher, Chief Engineer, Board of Port Commissioners.

Transfer from Student to Resident Member—Ralph H. Mann, Jahncke Dry Dock and Ship Repair Company.

PAPERS AND DISCUSSIONS

WHY LOUISIANA CONSERVES HER FORESTS

By R. D. Forbes,

Superintendent of Forestry, Louisiana Department of Conservation.

Read before the Society, April 11, 1921.

The entire story of forestry in Louisiana would take a much longer time to tell than you or any one else would be willing to give to the subject in a single evening. The Louisiana Department of Conservation, through its Division of Forestry, has been studying the subject intensively for the past three and a half years, and long before that far-sighted individuals had placed upon the statute books of our State laws looking to the conservation and perpetuation of this magnificent natural resource of ours—the forests of Louisiana. The details of the work that has been done to date by the department, and the laws which have been passed to make this work possible, I will not attempt to go into tonight. I do, however, want to place before you some of the reasons why Louisiana feels it necessary to conserve her forests. Time and again in the past thoughtless people have said "Why all this bother about forestry in Louisiana?" Do we not have timber in vast quantities today, and when ours is gone will we not have the great western country to call upon, and after that the unexplored depths of Siberia and the Valley of the Amazon? Besides, ought we not to cut down the forests of Louisiana and make way for the plow of the farmer and the cattle of the stock-raiser?"

It is indeed true that Louisiana has today a magnificent lumber industry. Her output of forest products was first among all the states of the Union in 1909, and since that year she has stood an unquestioned second to Washington. We have in Louisiana the greatest variety of trees of any State in the Union except Florida, and when it comes to commercial species of importance, Louisiana has no superior. We not only have five kinds of pine trees, as well as cypress, among the softwoods, but our hardwoods include a tremendous variety of the most valuable kinds. The lumber industry has been established on a large scale in Louisiana for better than 25 years, and yet today we have a greater quantity of standing virgin pine timber than any state in the South, by far the largest amount of standing cypress, and the largest body of almost unbroken hardwoods in the United States.

While the last three years have been abnormal in every way for the lumber industry, both in amounts cut and prices obtained for the product, it is safe to say that the value of the lumber alone produced in Louisiana is $125,000,000 annually on the basis of normal output and prices a little above the 1918 level. The lumber industry in our State today pays on an assessed value of some $214,000,000, represented by the manufacturing plants, the equipment, and the standing timber. This is in excess of the valuation placed on all of the agricultural lands, all of the pasture lands, the farming implements, and every head of live stock in the State. The lumber industry is far and away our leading manufacturing industry, and employs more than half of all the labor engaged in manufacturing. It is safe to say that not less than 75 prosperous towns in this State owe their existence to the presence of saw mills, and that one-quarter of a million of our people are supported by the saw milling industry alone, to say nothing of the many additional that are dependent in part or in whole on related industries, or those dependent upon the remanufacture of forest products.

So much for the present condition of the forest industries in Louisiana, which today produce more than six times as much lumber as the people of Louisiana consume. Why, say our critics, should Louisiana spend money on the conservation and perpetuation of her forests? Some may be willing to grant that this industry cannot last forever, and in casting about for arguments to fortify their position upon "wasting money" for forest conservation, they have hit upon the argument that that the forests of the West are estimated by the Federal Forest Service and others to have enough standing timber to supply the United States at its present rate of consumption with timber supplies for 50 or 60 years. And after that they tell us glowing tales of the so-called illimitable forests of frozen Siberia, that have never heard the blow of an axe or the rasp of a saw. Then, waxing eloquent, they whisk us half around the world to the umbrageous solitudes of the Amazon Valley, where, in addition to the customary boa constrictor and other popular conceptions of the geographies, there grow (they say) vast quantities of choice tropical woods. This "On to Siberia" movement sounds very plausible, and would be more convincing if it did not strangely resemble the philosophy of those who defended the total destruction of the forests of the Lake States on the ground that there was "plenty of timber in the South."

Unfortunately, all of this plausible theorizing does not work out in practice quite as it should. There still remains a great and a very pressing need for Louisiana to conserve her forests. Let us look at the facts and the situation squarely. A survey made by the Southern Pine Association in 1919 discloses the amazing truth that of 301 sawmills which were cutting pine in Louisiana in that year, only 32 had enough standing timber to draw upon to last beyond 1929. This does not mean, of course, that in 1929 the volume of pine manufactured in this State will drop to about 11% of the present output. Even should there be no growth in the pine forests of Louisiana from year to year, and consequently no new mills erected to take the place of those that have exhausted the virgin timber of their vicinities, the lumber production of the remaining 32 mills in 1929 will be nearly one-third of the total present output of the 301 mills. If the manufacture of cypress returns to normal proportions shortly, we have enough cypress left to carry the Louisiana industry for 20 years, and in the case of this tree it is improbable that any new growth will extend the life of the industry, cypress being our one tree of comparatively slow growth. As for our hardwood industry, there is bound to be such an expansion in the number of mills as soon as business in general becomes better, that it would be impossible to estimate the life of the industry. We do, however, know that hardwood supplies in the United States are becoming alarmingly low, due to the fact that comparatively little hardwood is grown to replace the virgin stands. Hardwoods in general require good soil, and the extension of our farms permanently cuts down the hardwood acreage. The supplies of certain hardwoods, like ash and hickory, are very critically low, with no substitutes in sight.

Can we replace these vanishing forest supplies of ours from the Pacific Coast, and after that from Siberia and South America? The answer is that perhaps we can, but only at a staggering cost in freight over and above the certain increase in lumber prices which comes as the sources of timber supply become more and more limited. The freight rate on lumber brought 2500 miles from Oregon to Louisiana is in the neighborhood of $28 per thousand. Whatever may be the present prices of lumber during our temporary business slump, it is plain that the day of really cheap lumber in the United States has gone by. When, therefore, one must add to high lumber prices at the mill a freight charge of $28 per thousand, and another inevitable charge of several dollars which comes from the the handling of any commodity at long range, it is easy to see that Louisiana must pay exorbitantly for West Coast lumber in the future. The Lake States, which in the nineties were producing nine billions of board feet, are today paying, it is said, six million dollars in freight alone on lumber brought in from outside. We are told that in Ohio certain classes of lumber cost $20 more than the same lumber at the point of manufacture on the Pacific Coast, even after allowing for freight charges. Another inevitable result of the withdrawal of our timber supplies away from the great centers in the East is a weakening of our national defense. We know that the railroad system of the country was in danger of serious breakdown during the world war; how much more difficult would have been the situation if the lumber necessary for the scores of cantonments in the East had had to be brought from the Pacific Coast! The difficulties of bringing the lumber from the Western United States to the East in time of peace or war would be many times increased if our timber supply in the future were to lie in Siberia or South America.

However, in spite of all the difficulties of transportation, the Southern States, and Louisiana in particular, might be fully justified in planning to bring their timber supplies from the West a quarter of a century hence, provided there was real and pressing need for new farm land, to be obtained only by the cutting away of timber. But there is no such need. There is perhaps no bigger obstacle to the practice of forestry in the South than the idea that every food of our land is agricultural, and that if we can only get rid of the trees, every one of our millions of acres will be converted into waving fields of corn, or snowy expanses of cotton plants. Certainly no one regrets that the fertile lands of Ohio and Indiana where once stood some of the finest of hardwood timber the world has ever seen, have long since been turned to the production of farm crops. It is folly indeed to raise trees on land which is capable of producing annually a rich agricultural crop. But what are the facts as to the agricultural developments of Louisiana? Out of some 28,000,000 acres in this State between 10,000,000 and 11,000,000 acres are in farms. We have it on the authority of agricultural officials of this State that in the last ten years, partly owing to the ravages of the boll weevil, and partly owing to labor and similar conditions, there is very little more land in cultivation today than there was ten years ago. Only 50% of our farm lands were classed in 1910 as improved. Today field after field that only a few years ago was in cultivation, is idle, and this idleness is scarcely overbalanced by the taking in of new land. Under these circumstances is it reasonable to say that we need to get rid of our forests, particularly those which grow on the less fertile soils, in order that we may convert the land into plowed fields?

Please understand that the Louisiana Department of Conservation is not opposed to the development of farming or grazing on cut-over lands. On the contrary, we are most emphatically in favor of all sound development that will give a living to an increasing population and will redound to the permanent fame of Louisiana as an agricultural state. We believe that a great cattle and live stock industry can be built up on our Louisiana cut-over lands, once we have eliminated the ticks and the grass fires, and have learned to handle our stock in smaller areas and with more intensive methods of feeding and handling. Our only contention with regard to agriculture on cut-over lands is that is is folly for us to overlook the present possibilities in reforestation of land, simply because at some future date the land may be in real demand for agriculture. It is better to grow timber than taxes, and taxes are the only crop which is being grown on hundreds of thousands of acres of cut-over lands in Louisiana today. At a relatively small expenditure for fire protection and seed trees a new crop of timber can be grown on any kind of cut-over land in Louisiana. There is no section of the United States, and probably of the world, where tree growth is so rapid and where natural reforestation is so easy to secure, as in our own South. We can produce paper pulpwood in Louisiana in 15 years; cross-ties, piling, telephone poles, in 25 years, and lumber in 35 to 40 years. The second-growth stands, under man's protection and management, will yield twice as much to the average acre as did the virgin stands. Our light-seeded pine stands will reforest naturally if two or three seed trees are left to the acre, and many of our hardwoods, such as the cottonwood, yellow poplar, ash, and tupelo, have seeds that are readily disseminated by the wind or flood water.

A minute or two ago I spoke of the fact that it is better to grow trees than taxes. This brings me to another prime reason for the conservation and perpetuation of the forests. Pine land that before cutting was assessed at an average of $48 an acre for taxation purposes is worth only about one-eighth as much after the timber has been cut away; the value of denuded cypress land ($2.84) is only one-twenty-sixth that of the virgin timber. Hardwood lands, which of all of our lands are most likely to be converted at once into good farms, are worth only one-half as much when cut-over as when timbered. It is such facts as these that raise the question, where are some of the parishes of Louisiana going to secure their revenue for schools and roads ten or twenty years from now, when the virgin timber has been practically cut away? Already we have some staggering figures to show how far the process of forest denudation has gone. For example, one piney woods parish has today only 35,000 acres of virgin timber as against 335,000 acres of cut-over land; in another parish the proportion is 25,000 acres of virgin timber to 355,000 acres of cut-over land; and so it goes. There are only five parishes in Louisiana which have more virgin timber than cut over land. For the State as a whole there are but 4,715,000 acres of virgin timber to 12,725,000 acres of cut-over land. The parishes and the State have not in the past felt the pinch in taxes which would ordinarily be occasioned by the progressive cutting of the forests, simply for the reason that assessed values on the virgin timber remaining have been steadily raised, in common with the values of many other forms of property, so that the total assessment in most parishes has either increased or at least not diminished. To give a single example, the best pine land in Louisiana was assessed at $20 an acre in 1906. Today nearly four hundred thousand acres are assessed at $88 an acre. We may be able to get our lumber from Oregon and Washington, but the question is will Oregon and Washington send us along some taxes at the same time?

The effect of the depletion of the forests will be felt all through our economic life in this State. Already there are in Louisiana many little flag stations on our railroads that were once prosperous sawmill towns. The mills, unlike the forest industries of Europe, were not planned to cut each year only as much as the surrounding forests would grow in that same year. When the timber ran out the mill shut down; the bank closed up; merchants moved away; houses tumbled down, and grasses grew in the streets; schools shrank to one-room size, or were absorbed by those of neighboring sawmill towns, only a little less ephemeral than they. The chartered tramroads which used to run out into the woods and surrounding country surrendered their charters and pulled up their tracks. Cheap and direct transportation, so necessary to the success of those types of farming most likely to be successfully conducted on the piney woods soils, was withdrawn, and the farms which had sprung up in response to the local markets and to accessibility to wider markets quickly reverted to briars and pine trees. So far as the local residents were concerned the lumber industry came, lived an existence of 15 or 20 years, and moved on, without little benefit to anyone. That this process, everywhere repeated, is draining our state of a great heritage, with little permanent gain to the citizens of Louisiana, is now recognized and is the fundamental argument behind our present severance tax.

Louisiana conserves her forests, then, not because five years or ten years, or even twenty-five years, will find her without a stick of timber or a cord of stove wood. She does not conserve them primarily because if she does not grow some more forests of her own she will have to spend millions in freight on lumber brought in from Oregon and Washington, or shipped from the hypothetical forests of Asia and South America. She conserves them because literally millions of acres of her land may be made through reforestation to produce untold wealth, acres that barring a miracle of some kind will otherwise remain desolate and relatively unproductive for decades, and perhaps permanently. She conserves her forests because without forest values the majority of her parishes must become poverty-stricken or bankrupt, and because with the passing of a great manufacturing industry will pass employment or support for a quarter of a million of her citizens.

FEDERAL AID IN THE CONSTRUCTION OF PUBLIC ROADS

By Henry B. Cooley,
Senior in Civil Engineering, Tulane University.

In the earlier days in the United States, roads were constructed without any care, and no thought was given to maintaining them. The first roads across our country probably followed the old Indian trails which in turn were preceded by animal paths which followed the lines of least resistance, so that there was no work done in laying the roads out. Later came the day when each farmer living on the road built and repaired the road in front of his property and possibly further, if such was necessary, to get his produce to the market. Still later, the townships took over a large part of the road building and levied taxes on all property owners within its limits in order to pay for roads laid within those limits. This township action was followed by similar action by the county, the state, and finally by the Federal Government. The roads built with the aid of the United States Government, with the exception of the roads in the National Parks and National Forests, which are built entirely by the Government, are known as Federal Aid Roads and it is this type of roads which is referred to in the following.

For nearly a century prior to 1915 the Government had taken no part whatever in the improvement of the roads of the country. On July 11, 1916, however, President Wilson signed the measure generally known as the Federal Aid Road Act, under which the government has since co-operated with the states in the construction of highways. This measure provided for an appropriation of $75,000,000 to aid states in the construction and improvement of forest roads. The enactment of this measure rounds out the most comprehensive scheme of co-operation in road building ever put into effect by any nation, for this new policy did not contemplate the construction of Federal roads as a separate system apart from the systems of state and local roads; on the contrary, it aimed to stimulate the construction of the roads of the country through the agency of the State highway departments. The appropriation of $75,-000,000 for rural post road construction was made available at the rate of $5,000,000 for the fiscal year that began July 1, 1916, $10,000,000 for the next year, $15,000,000 for the third, and so on for five years ending June 30, 1921.

After four years of operation under this plan it is appropriate that we stop for a moment to review the methods which have been adopted by the government and the states in putting into effect the purposes of the act, and to examine the progress that has been made.

One of the earliest and most far-reaching results, directly attributable to the act was the creation of adequate State highway departments in seventeen states, which previously had either no highway department at all, or which had departments insufficiently equipped to do the necessary work. In one year after the passage of the act, more constructive State Highway legislation was passed than had ever before been enacted in this country in a similar period, and a condition was brought about, at least as far as road legislation was concerned, which otherwise would not have been reached for five or ten years.

The insistence of the Government upon the construction of Federal Aid roads under the supervision of engineers of the State departments has resulted in the placing of more and more of the road work of the country under skilled supervision. In 1920 the State departments had supervision over 80% of the funds available for road construction, while in 1915, the year before the Federal Aid act was passed, they only had control of 30% of the funds.

In 1915 the total expenditure for roads and bridges by all State and local governments was only $276,000,000. In 1920 it was estimated that the funds available for main road construction alone was approximately $663,000,000, or more than double that spent for the year immediately preceding the passage of the Federal Aid Act.

The actual road operations under the act thus far involves the approval of projects, the aggregate length of which would span the distance between New York and San Francisco nine times, and the estimated cost is nearly as great as that of the Panama Canal. There were in 1920, 15,944 miles of road under construction, equivalent in length to five roads from the Atlantic to the Pacific; and the equivalent of 5500 miles of road had been completed.

The year 1917 marked the opening of the actual construction work under the terms of the post-road provision of the Federal act. At the close of January 31, 1918, there had been approved by the Secretary of Agriculture 253 individual projects, aggregating 2849.48 miles and calling for an expenditure of Federal funds of \$7,324,721.72 and of State and local funds of \$9,917,-143.70, making a total estimated cost of \$17,241,865.42. These projects represented applications from 44 of the States, so that up to that date only four states had not reached the stage of actual construction.

About 60% of the total allotment of Federal funds which has been approved will be spent for roads of such durable types as bituminous concrete, Portland cement, concrete and vitrified brick; and these roads when completed will increase by 7600 miles the total of 14,400 miles of roads of this class which existed in the whole United States the year before the Federal Road Act was passed.

Every type of road construction recognized by highway engineers as practicable was represented in the project mentioned above. Of the total mileage of road involved in projects approved up to the close of January, 1918, the percentatge of the types of construction represented were approximately as follows: Brick, 2.62%; water bound macadam, 2.95%; bituminous macadam, 5.63%; cement concrete, 8.9%; sand clay, 15.6%; earth, 32.1%; gravel, 32.1%. For some reason the impression prevails that the Secretary of Agriculture would only approve the higher types of road surface, such, for example, as brick, concrete, and bituminous macadam, although the secretary tried to remove this impression in a specific statement issued to the public on February 17, 1917.

"There is not the slightest truth in such a report," said Secretary Houston. "This department, which is charged with the administration of the Federal Aid Road Act, has placed absolutely no restrictions either direct or implied upon the kinds of highways to be constructed. States may submit for approval any kind of road, even an earth road, and approval will be given if the construction be substantial in character, suitable for traffic needs, and meets the terms of the Federal Act. To give State legislators and highway officials the impression that this department favors only costly types of roads, or discriminates in favor of any particular material, results not only in spreading misinformation, but in placing barriers in the way of States which wish to avail themselves of Federal aid in road construction."

The apportionment of the post road appropriations of the States, is based upon area, population, and mileage of rural delivery and star routes in each State, each of these factors having a weight of one-third. The Federal Aid Act applied to the construction of roads in rural sections only. Rural sections are defined as those places which show on the last Federal census a population of not more than 2000 (later amended to 5000), or sections of towns with a greater population where the houses on the road for a distance of one mile shall not be closer together than 200 feet.

Federal funds may be expended only for construction, must not exceed 50% of the value of the roads, and in the original act it was provided that the expenditure of government funds could be in no case in excess of $10,000 per mile exclusive of bridges of more than 20 feet clear span. This provision was amended later, and the amount of Federal funds which could be expended was increased to $20,000 per mile. Assuming that the State furnishes only 50% of the cost, which is the minimum allowed under the act, a road costing $40,000 per mile could be built. If a larger sum was required the State would have to pay it.

The act laid down three requirements with which the States had to comply before they could receive allotments of Federal aid; first, that the State legislatures should assent to the provisions of the act, or that the governors of the States in which the legislative bodies were not in session should assent, pending the convening of the legislatures; second, that each state should have direct supervision over the construction on which Federal funds were to be expended; and, third, that the Federal aid should be met by an appropriation of at least an equal amount of State funds. A number of states in turn require certain conditions to be met by their counties, but as the Secretary of Agriculture deals only with the State highway department, the State in meeting Federal requirements, acts for the counties wherever their interests are involved.

There was an immense amount of preliminary work necessary before the terms of the act itself could be put into operation. First the Secretary of Agriculture was required to apportion the Federal funds for the first fiscal year to all of the states.

The act next required the establishment of rules and regulations, and in their preparation it was necessary that the views of the several State highway departments should be given careful consideration. The act was approved July 11, 1916, and ten days later, July 21, 1916, the certificate of apportionment was issued. The rules and regulations were prepared after a conference with the State highway officials and issued September 1, 1916. After that it was necessary to ascertain which of the states were equipped with highway departments within the meaning of the act, and to await the assent of the state legislatures to the provision of the act, or of the governors pending the convening of the legislatures, in those states in which the legislative bodies were not in session, so that it was 1917 before the actual construction work could be undertaken under the terms of the act.

At the outset the States were required to settle upon a definite system of the roads in the construction of which they would ask for Federal aid. These systems were selected and maps of them were turned over to the Bureau of Public Roads. Except in about 5% of the projects, where the desirability of revisions in these systems has since been made evident, the apportionments of aid to the states have been expended upon parts of these systems. These systems involve about 214,000 miles of road, or only about 8% of the total 2,500,000 miles of road in the United States.

The work had hardly begun when war with Germany was declared on April 6, 1917—and from that time until the signing of the armistice, nineteen months later, all the energies of the Nation were directed to winning the war; and Federal aid road construction was curtailed wherever possible, to release vitally necessary men and materials for the more important purposes of war.

Something over three months after the signing of the armistice, on February 28, 1919, the President in signing the post-office appropriation bill for 1920 approved amendments to the original Federal Aid Act of 1916. These amendments provided that the term "rural post roads" as used in that act was to be construed to mean "any public road, a major portion of which is now used, or forms a connecting link, not to exceed 10 miles in length of any road or roads now or hereafter used for the transportation of the United States mails," and further increased the limitation of $10,000 per mile to $20,000 per mile as mentioned above.

Before these amendments were passed no project could be approved by the Secretary of Agriculture unless it could be ascertained either that the mails were actually carried on the road or that they would be carried on it within a reasonable time after its completion. A large number of projects had been submitted by the states which the Secretary of Agriculture could not approve because of doubt as to their status as post roads. The passage of the amendment with its broad construction of the term "rural post roads" permitted the secretary to approve these projects, all of which were for important roads and cleared the way for a far more logical selection of the roads to be improved. The amendment also made it possible for the States to devise more compact State systems on which to apply for Federal aid without the danger of having parts of the system ineligible under the original definition of post roads.

This bill carried an additional appropriation of $200,000,000 for the construction of Federal aid roads, which was made available in installments of $50,000,000 immediately, $75,000,000 for the fiscal year ending June 30, 1920; and $75,000,000 for the year ending June 30, 1921.

Under the law the Secretary of Agriculture is charged with the administration of the provisions of the Federal Aid Act. He in turn has delegated the duty of caring for the details of the administration to the Bureau of Public Roads. This bureau was, and is now, in closer touch with the highway situation and requirements of the country than any other agency in the United States. Under any other agency Federal operation would have been delayed to permit of the acquisition of necessary preliminary data, which the Bureau of Public Roads had at hand, ready to utilize without delay.

The organization under the chief of the Bureau of Public Roads which cares for the details of the administration of Federal aid funds consists of a headquarters force headed by the chief engineers of the Washington office, and 13 district engineers in charge of the work in 13 groups of States. The districts vary in size. One embraces only the State of California, others include four or five States, the largest one includes eight States. The district engineers are assisted by a number of engineers who have supervision over the sections of the district work. Where the work is heavy enough to warrant it, one or more resident engineers have been placed in a State. In other districts, men are assigned by the district engineer to cover special States, but do not have headquarters in those States. These men are authorized to approve slight changes in plans which become necessary as the work progresses, such as the change in size of waterways, location of culverts, slight changes in grade and alignment, and even more important changes provided they do not involve the government in additional expense. By thus making it possible to effect minor engineering adjustments on the ground, a great deal of time is saved which would be lost if it were necessary to refer all such matters to Washington.

The Federal Aid Act requires that projects for the Federal aid shall be initiated by the States. As the first step a statement is forwarded to the district engineer announcing that the State proposes to build a piece of road of a certain length and type in a certain location. This statement is known as the project statement and it must be accompanied by an approximate estimate of the cost of the proposed construction. The project statement is examined by the district engineer with the purpose of determining whether the project complies with the Federal Aid Road Act. If, in his opinion, it does, he forwards the statement to the Washington office with his recommendation. It is there examined by the chief engineer and his assistants, and if the chief engineer agrees with the district engineer, the project is placed before the Secretary of Agriculture by the chief of the bureau, with the recommendation of the bureau, for his approval.

Until the secretary has signified that the Federal government will co-operate, no further action is taken by the State. If the secretary approves the State is so notified, and then proceeds to prepare detail plans, specifications and estimates of the work. According to recent reports over half of the projects handled are passed by the district offices in an average of five days, while 90% of all projects received at Washington are passed by the Bureau in an average of four days.

After the plans and specifications have been prepared by the States they are submitted to the district engineers, together with a revised estimate of the cost based on the carefully computed quantities of work to be done. A representative of the district engineer, either the Federal engineer resident in the State, or one especially assigned, makes an inspection of the sight of the proposed work, and on this inspection the district engineer bases his recommendation for approval or disapproval of the plans. Very frequently the Federal engineer does not wait until the plans are completed, but goes over the road to be built with the State engineer, and he is often able in this way to suggest changes in the plans as contemplated which facilitate their approval when they are completed.

As soon as the plans, specifications, and estimates are recommended for approval by the district engineer, the State may advertise for bids and let the contract. There may be minor adjustments and changes to be made in the plans before they are finally approved by the Secretary, but generally speaking the States do not wait for all these matters to be cleared up before they start on the project. The records of the Bureau of Public Roads show that the plans, specifications and estimates for over half of the projects are passed through the district offices in an average of 5½ days and about 90% receive the approval of the chief engineers in 3½ days.

After the plans, specifications and estimates have been approved the co-operation of the government is practically insured. The signing of the formal project agreement follows, but it is not necessary that the work be delayed pending this formality. The authority granted by the secretary to proceed with construction before the formal completion of the agreement has practically removed all cause for criticism of the government on the ground of delay.

To cover the cost of administrative work of the government, an amount not to exceed 3% of the total appropriation for Federal aid is reserved. As the total cost of Federal aid projects is more than twice the amount of the Federal aid apportionment to them, the administrative allowance is really less than 1½% of the total cost of the roads constructed.

The law requires that any construction undertaken under the Federal Aid shall be "substantial in character." Further than this the determination as to type of the selected roads is left to the joint decision of the Secretary of Agriculture and the State Highways Departments.

In interpreting the word "substantial" the secretary has recognized the fact that an improvement which is substantial for one density and kind of traffic may not be substantial for another. It has been recognized that the types of roads which it is desirable to construct in New York, Massachusetts and Pennsylvania are not suitable or necessary for Nevada, Idaho and the Dakotas.

The Federal aid act specifically forbids the use of Federal money for maintenance of the roads constructed with Federal aid. The States are expected to maintain the roads constructed; and to enforce proper attention to this important matter, it is provided that further allotments of aid may be withheld from any State which fails to keep its Federal aid roads in repair. So far it has not been necessary to invoke this provision of the law, and it is unlikely that any State will in the future so far neglect its own interest in the roads constructed as to permit the dissipation of its investments in the roads by failure to keep them in repair. The Bureau of Public Roads, however, is making periodic inspections of the roads which have been completed, and will continue to do so, and the States are expected to comply fully with the terms of their contract with the government.

On the whole the Federal act now appears to be working smoothly, and co-operation with each of the forty-eight States along practical lines seems assured. Whether the application of the co-operative principle to this vast enterprise will produce the largest possible measure of benefit to the Nation cannot yet be determined, but certainly if the difficulties of operation may be surmounted it should follow that the tremendous effort of all the forces of the Nation working to a common purpose should accomplish amazing results in the building of the Nation's highways.

ssie, 113

WASTE IN INDUSTRIAL PROCESSES

Issued by American Engineering Council.

St. Louis, June 3.—Waste in industrial processes is causing enormous annual losses to the nation, it is declared in a report of the American Engineering Council's Committee on Elimination of Waste in Industry, made public at a meeting of the Council's Executive Board here today. "Over 50% of the responsibility for these wastes," the report says, "can be placed at the door of management and less than 25% at the door of labor."

The findings of the committee, which was appointed by Herbert Hoover, cover investigations, or "assays" of various typical and important industries and reveal not only the many causes of waste but also recommendations for elimination.

The investigation found that the margin of unemployment mounts to more than a million men, that billions of dollars are tied up in idle equipment, that high labor turnover is a rough index of one of the commonest wastes, and that the waste of time and energy and money through duplications and estimates and bids in the building trades runs into millions annually.

Both employer and employee restrict output, it was said. Both capital and labor are blamed for existing abuses, but the annual losses through waste by conflicts between them is much less than popularly supposed.

Between four and five million workers were idle during January and February of this year. In 1921 half a billion dollars will be lost in wages in the building trades, it is said. Nationwide machinery to obtain continuous information concerning unemployment conditions throughout the country is called necessary. Means for regularizing employment in the principal industries is also urged. An elaborate plan of nationwide cooperation between the government, the public, trade associations, the industries, labor, bankers and engineers is outlined.

The waste inquiry was in charge of a committee of sixteen, headed by J. Parke Channing of New York as chairman, and L. W. Wallace of Washington, executive secretary of the American Engineering Council of the Federated American Engineering Societies, as vice-chairman.

The inquiry was carried on by a large force of field workers who obtained first hand information of conditions existing in the leading basic industries of the nation, particularly in New York, New England and Pennsylvania. The results, it was stated, are typical of the industry of the entire country. The investigation is the beginning of a movement by the country's organized engineers, about 200,000 in number, to bring about better industrial conditions and more harmonious relations between capital and labor.

The committee was named by Mr. Hoover on January 12 and the speed with which the investigation was carried on by the investigators was made possible by full co-operation on the part of management, labor, engineers, and public officials.

The full report of the comittee comprises 125,000 words and deals with the deep-seated causes of waste, and, it is said, does not consider "the present business crises, due in part to world-wide waste and extravagance caused by the war," as an excuse for transitory experiments, but as an opportunity to point out the need for permanent reform.

The report deals exhaustively with housing and building, ready-made men's clothing, shoes, metal trades and printing. These industries were not chosen, it was said, with any desire to hold them up as bad examples.

The findings are characterized as not exceptional, and American industry as a whole is said to suffer from the same defects as those found in the industries studied.

"This report is the first work undertaken by the Federated American Engineering Societies in rendering public service," the report added. "It discloses losses and waste due to the restraint and dissipation of the creative power of those who work in industry. It lays the foundation for knowledge of the destructive influences which have too much controlled in the past. From this knowledge will grow the certain vision that mental and moral forces must be added to the physical resources now employed if industry is to serve all who are dependent upon its continuous and effective operation."

"Waste," the report asserts, "results from an interruption of production, low production, restriction of production and lost production." The wastes of interrupted production, it is said, result from idle men, materials, plant and equipment and are summarized as follows:

"The margin of unemployment amounts to more than a million men; cyclied industrial depressions are causes of waste through idle men, plan equipment and material; intermittent employment is not merely the cause of one of the largest wastes in industry, it is also the one big problem for which labor demands a satisfactory solution; waste results from conflicts between management and labor, but the amount is much less than is popularly supposed; large inventories of raw materials and finished product and unbalanced production are causes of waste resulting from idle materials; large sums of money are invested in idle equipment and overequipment; and factory buildings in many instances are larger than necessary."

Wastes attributable to faulty management are ascribed to:

"The average method of management is far behind standards which have demonstrated their practical value; billions of dollars are tied up in idle equipment, and there is a large additional waste through maintenance and depreciation charges; manipulations in raw material result in serious losses; present sales policies are a contributing cause of irregular production; an evil in some instances is the practice of cancellations and returns; high labor turnover is a rough index of one of the commonest wastes in industry; the waste of time and energy and money through duplication of estimates and bids in the building trade runs into millions every year; quantity figuring by all bidders is a duplication of effort and a source of waste in construction work."

As to restricted production, the report says:

"Both employer and employees restrict output, the former usually by limiting the total output of an industry, the latter by limiting the rate of speed of output of individual workmen, as indicated by the following:

"Maintenance of high prices on the part of the owners influences the situation; collusion in bidding as frequently practiced in the building trades is a restriction; legitimate restrictions are frequently practiced by owners of patented, copyrighted or trade marked articles; the amount of a day's work is restricted by labor in the building trades; restrictions of apprentices in many cases seems extreme and unfair; the restrictions of the output of machines by limiting the number one man can operate is a charge against the unions; the practice of craft distinctions that members of one craft union shall not encroach upon the work of another results in large waste and little benefits; labor union interference with the method of wage payment often restricts production."

Ill health and industrial accidents figure in the causes of lost production, the findings as to which are summarized as follows:

"The economic loss in this country annually from preventable diseases and death is over $3,000,000,000; 42,000,000 persons gainfully employed lose 350,000,000 days from illness and disease and non-industrial accidents annually; 42% of the wastes of ill health is preventable; in 1919 there occurred in industry 3,00,000 accidents resulting in an economic loss to the country of about $853,000,000; industrial accidents are caused by the carelessness of the workmen and a lack of ordinary safeguards; authorities agree that it is possible by using methods already perfected, to reduce deaths and serious accidents in American industry by at least 75%."

The committee offers recommendations for the culmination of waste in production and outlines the following proposed program of governmental assistance:

"A National Industrial Information Service should be established to furnish more timely, regular and complete information covering current production and consumption and stock of commodity; a National Statistical Service should be established covering employment requirements; a national policy regarding public health should be fostered and encouraged; the material program for industrial rehabilitation should be encouraged and should offer opportunities for education and placement to those having physical defects as well as those handicapped because of industrial accidents; a nationwide program of industrial standardization should be encouraged in conjunction with industrial interests; the government should recognize the necessity for a revision of such federal laws as interfere with stabilization of industry; a body of principles should be accepted which could be developed for the adjustment and settlement of labor disputes.''

Public support for the movement to wipe out waste in industry should be had, the report says, in the following ways:

''Public recognition of the fact that a greater stabilization of style would lessen the demoralizing effect of seasonal fluctuations; public demand should be distributed more evenly throughout the year; Chambers of Commerce and other civic organizations should assist industry by educating the public in better methods of buying; architects, engineers and contractors should jointly use their efforts to establish facilities for making quantity construction surveys.''

Trade Associations, it is declared, should help and for these the following program is outlined:

''Trade associations should be formed in those industries lacking comprehensive organizations; greater co-operation and publicity should be established within certain industries by improving and increasing the effectiveness of existing trade organizations there should be recognization of the importance of the collection and distribution of trade information; trade associations should realize their opportunity to promote programs for the standardization of cost accounting methods, the introduction of standardized material specifications, the establishment of production standards, the standardization of equipment and the standardization of finished products; these associations should establish greater co-ordination of activities and relationships between interdependent and intertradependent agencies and organizations; the associations should encourage industrial research; industrial trade councils such as have been established here and abroad are worthy of careful study; a nationwide system of employment exchanges should be established and maintained.''

Taking up the responsibility of plant management, the report says that administrative policies should cover:

''Improvement of organization, administrative and management control; the stabilization of production; introduction of effective employment methods; creation of individual or collective research departments; industrial education; curtailment of practice of adjustments; cancellations and returns where customary; development of purchasing schedules; correlation of sales policies with production; accident prevention.

"Management should see to: Reduction of high labor turnover; establishment of improved relationship with employees; maintenance of inspection control, maintenance of plant and equipment; co-ordination of quantity and quality requirements.

"Emphasis should be directed to production control of the following: Introduction and perfection of material schedules and control; introduction of detailed planning of work in advance; routing and scheduling of work in process; improvement of shop methods; elimination of congestion between departments.

"Standardization calls for: Establishment of production standards based on through scientific analyses; standardization of cost accounting systems; scientific rate setting; standardization of materials; standardization of operations; standardization of plant and equipment; standardization of product and development of performance standards."

Labor, it was said, should co-operate in the following ways:

"Organized labor should develop a policy for increasing output; the attitude of opposition or indifference to proper standards for production should be changed and a frank and aggressive insistence on such standards; there should be a scientific examination of the bases of wages; certain union rules should be modified in regard to machine operation, apprentices and craft distinctions which result in restriction of output; individual workers should realize their responsibilities for waste resulting from ill health and disregard of safety measures."

The banking interests, it was said, should especially encourage the stabilization of industry and that it was the duty of the engineers of the nation to support a wide and more thorough research into the following problems:

"Collective bargaining; hours of labor; methods of compensation; means of preserving and stimulating the creative instincts and the pride of craftsmanship of industrial workers; a standard labor and management terminology; common principles for the methods of management; and the measurement of production standards.

"Intermittent employment," it is said, "is the result of lack of stabilization in industry. This condition is due to a variety of causes, among them, seasonal irregularity in demand, lack of co-ordination between related industries, maagement's failure to link up sales policies with production policies, the so-called 'sell then make' policy. Lack of industrial research, lack of planning and control, speculative purchasing of raw materials, shutdowns for annual inventories and other wasteful practices.

"One consequence of seasonally recurring anxieties and sufferings on the part of the workers is a cumulative antagonism toward their employers and toward employers as a class. Another consequence is a concrete, but fallacious industrial philosophy, namely, the 'make work' theory; i. e., the belief that 'there is only so much work to be done,' and that the sensible course of action for workers is to retard production so as to make emplyment last throughout the year. A lack of knowledge of the fundamental economic principles involved is one of the prime causes for restrictions in output."

As to idle material, the report says:

"The waste of idle material in large inventories of raw and finished materials is very large. Unbalanced production also results in a very large material idleness; such examples as the following are fairly common:

"A shoe factory having a capacity of 2400 pairs of shoes a day could turn out for a considerable period only 1900 pairs because of shortage of racks due. Another factory had 50,000 pairs of shoes tied up in the fitting room instead of the normal 15,000 because of congestion of operations. In another case a factory producing 700 pairs of shoes a day had 36,000 pairs in its fitting room, or ten times the normal supply. An entire factory was held up for several days waiting for leather heels."

Very large waste is said to exist through plant idleness. In the printing industry vast sums of money are tied up in unnecessary stock resulting from great duplication of brands of paper. The present investment of more than a hundred million of dollars in stocks of paper carried on hand to meet trade requirements of the printing industry, it is said, could be cut in half through standardization.

The building industry was said to be about 60% efficient. In the shoe industry the waste is put at about 35%. The average plant in the metal trades group is from 25% to 30% behind the best plant in output per employee.

In the ready-made clothing industry, the report says it should be relatively easy to save three-quarters of a million dollars a day—an increase of 40% in effectiveness. The value of the output in this industry is put at $600,000,000 a year.

The committee which directed the nationwide assay of industry was composed of the following: Herbert Hoover of Washington, L. P. Alford, New York; George D. Babcock, Syracuse; F. C. Colburn, Philadelphia; Morris L. Cooke, Philadelphia; Harington Emerson, New York; Ira N. Hollis, Worcester, Mass.; E. E. Hunt, Washington; C. E. Knoeppel, New York; Robert Linton, New York; Fred J. Miller, New York; H. R. V. Scheel, Passaic, N. J.; J. H. Williams, New York; Robert B. Wolf, New York; J. Parke Channing, Chairman, New York, and L. W. Wallace, vice-chairman, Washington.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Regular Meeting of the Board of Directors, April 11, 1921

The regular meeting of the Board of Direction was called to order with Chairman Manley in the chair and the following present: Messrs. Barelli, Derickson, Lawes, Moses, Robert.

Ballots for new members were opened, there being 85 formal and one informal ballots cast with the following results:

Resident Members, Charles C. Crawford, Eugene N. Ehrhart, Allen S. Hackett, Walter S. Winship.

Transfer from Junior to Resident Member, Eugene M. Hornot.

Non-Resident Members, Waddy T. Drew, Roger I. Tanner.

Associate Member, Howard H. Marsh.

Student Member, Simon B. Schwartz.

The membership of Mr. Peyton Wood was changed from Non-Resident to Resident grade.

The financial report of the Secretary was read and approved and bills ordered paid.

There being no further business, the meeting was adjourned.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Society, April 11, 1921

The regular meeting was called to order with President Manley in the chair and 34 members and guests present. The minutes of the previous meeting were read and approved. Statements were made by Messrs. Moses and Gregory relative to the meeting of the American Society of Mechanical Engineers in Mobile on April 22.

The following resolution requiring the endorsement of the Society was offered by Mr. G. W. Lawes:

Whereas, The protection and conservation of the public health is of paramount importance in the industrial and commercial development of a State, and in the maintenance of happiness, contentment and prosperity of its people, and

Whereas, Discoveries in Sanitary Science have led to developments and activities in public health work, particularly in the field of environmental sanitation, that are not medical in their nature; for example, water supply and water purification, sewerage and sewage disposal, waste disposal, stream pollution, drainage for malaria control, ventilation, etc., and,

Whereas, Under the present constitution membership on the body having charge of the protection of the public health is limited to physicians, therefore

Be it Resolved, That the Louisiana Engineering Society recommend to the Constitutional Convention now in session that this limitation be removed and that provision be made for representation of the engineering profession on this Board.

This resolution when put to a vote was carried. According to the rules of the Society this resolution must again be put to a two-thirds vote at the next meeting before being finally adopted. Accordingly, it was moved and duly seconded that a special meeting be held on Monday, April 18, 1921, at which time this resolution will come up for a second reading.

The technical exercises consisting of an address by Mr. R. D. Forbes on "Why Louisiana Conserves Her Forests," were then proceeded with and heard with much interest. After considerable discussion Mr. Forbes was accorded a rising vote of thanks. There being no further business the meeting was adjourned to the usual collation.

JAMES M. ROBERT, Secretary.

Special Meeting of the Society, April 18, 1921

Meeting was called to order with Vice-President Derickson in the chair and 10 members and guests present. Minutes of the previous regular meeting were dispensed with. This meeting was called for the purpose of endorsing for the second time the following resolution which was read to the Society:

Whereas, The protection and conservation of the public health is of paramount importance in the industrial and commercial development of a State, and in the maintenance of happiness, contentment and prosperity of its people, and

Whereas, Discoveries in Sanitary Science have led to developments and activities in public health work, particularly in the field of environmental sanitation, that are not medical in their nature; for example, water supply and water purification, sewerage and sewage disposal, waste disposal, stream pollution, drainage for malaria control, ventilation, etc., and, Whereas, Under the present constitution membership on the body having charge of the protection of the public health is limited to physicians, therefore

Be it Resolved, That the Louisiana Engineering Society recommend to the Constitutional Convention now in session that this limitation be removed and that provision be made for representation of the engineering profession on this Board.

Upon motion by Mr. Carr, seconded by Mr. Delery, the matter was carried unanimously for the second time and in consequence the Society endorsed the above resolution.

There being no further business, the meeting adjourned.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Board of Direction, May 9, 1921.

The regular meeting of the Board of Direction was called to order with the following present: Messrs. Manley, Derickson, Moses, Barelli, Robert, Lawes and Riess.

Upon motion duly seconded the following applications were ordered through the ballot: Messrs. Joseph B. Converse, Daniel S. Elliott, Herbert M. Gallagher, Alfred A. Lanaux, Ralph H. Mann.

The application of Mr. Alfred A. Lanaux was ordered sent back to the Membership Committee with the request that they reconsider his case. The Membership Committee recommended Mr. Lanaux for Associate membership and the Board of Direction raised the question whether or not it should not be full membership.

Upon motion duly seconded the resignation of Mr. Maybin Wilson was accepted as of December 31, 1920.

There being no further business, the meeting adjourned.

JAMES M. ROBERT, Secretary.

Regular Meeting or the Society, May 9, 1921

The meeting was called to order with President Manley in the chair and 42 members and guests present. Minutes of the previous meeting were read and approved and reports of the special meeting were stated orally by the secretary.

There being no regular business for the Society to transact, the meeting was turned over to the Local Section of the American Society of

Mechanical Engineers, Mr. E. W. Carr, Chairman, Mr. W. B. Moses, Secretary.

The technical exercises were then proceeded with and Mr. E. W. Burbank read an exceptionally interesting and instructive paper entitled: "Certain Features Relating to Hydraulic Turbin Design and Settings." After considerable discussion which was enjoyed by all present, the meeting was turned back to the Louisiana Engineering Society and then adjourned to the usual collation.

JAMES M. ROBERT, Secretary.

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PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

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CONTENTS

EDITORIAL NOTES AND COMMENT: PAGE

The Hydraulic Turbine 145

Wood Preservation 147

Costs 147

The Military Engineer 148

PAPERS AND DISCUSSIONS:

Certain Features Relating to Hydraulic Turbine Design and Settings. *By E. W. Burbank* 150

Wood Preservation, *By Henry E. Rodrigues* 174

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY 182

EDITORIAL NOTES AND COMMENT

The Hydraulic Turbine.—Probably no single piece of engineering apparatus deserves greater attention, and is at the present day receiving greater attention, than the hydraulic turbine. And this really means the hydro-electric turbine, for the simple reason that the great problem of the development of one energy resource is turning more and more insistently for its solution to the increasing use of water power throughout the whole world. And as a rule the best sources of water power being situated at points distant from already developed centers of industry, necessitates an efficient system of generation and transmission, which is so excellently furnished by the use of electricity as the medium. It would seem as if the modern large-size electric generator has been developed almost to the point of maximum efficiency, but even so, it would be a rash assertion to say that we have reached that point; for the constant efforts of scientific and technical men in the various fields of research are constantly productive of new ideas which may be turned to account in the ever present problem of increasing the efficiency of engineering apparatus.

The transmission line has also been developed to a high degree of efficiency, but almost every new installation these days bears witness to the application of new principles each of which adds something to the efficiency of the line. It is natural, therefore, for us to look to the older unit of the system, the hydraulic turbine, to see where improvements may be effected to the end of securing increased efficiency.

Mr. Burbank's paper discusses the more important phases of the problem of design of the turbine for the purpose of securing maximum efficiency.

Of these, one of the most important is the proper proportioning of speed and head. In this connection one is made of a special factor called the "specific speed of the runner," which is explained in the paper.

The design of the runner is also a most important item; so much so, in fact, that with the larger companies it has become the custom in certain new installations to design a model runner of sufficiently large dimensions to enable the engineers, through an official test, to determine the performance curves of the particular design.

With the great improvements in details of the hydraulic turbine it is now possible to develop heads as low as six feet and as high as 6000 feet, by the careful selection of the type of turbine. Large single runner turbines are being rapidly developed to-day, taking the place of the older types with multiple runners.

The proper design of draft tube to insure as large as possible effective head by a reduction of the back pressure has called forth many ingenious ideas and plans from the designers. Hydraulic engineers give this portion of the turbine the somewhat anomalous title of "regainer of energy," meaning, of course, not that any energy is regained after the water leaves the turbine, but that the back pressure is reduced, thus increasing the effective head.

One of the most recent and most effective of these "regainers" is the invention of Mr. William White, formerly of New Orleans, and now Chief Engineer of the Allis-Chalmers Company. It is known technically as the White Hydraucone Regainer. Mr. Burbank does not give a description of it in his paper, but the cut of the large electric unit shows it quite plainly, and it has been described in Mr. White's paper read before the American Society of Mechanical Engineers.

Wood Preservation.—During the second term of the Session of 1920-21, The Creosoted Materials Co., Inc., of New Orleans, offered a prize of $50.00 to the senior engineering student of Tulane University who would submit the best essay on the subject of Wood Preservation.

This contest was participated in by some eight or nine seniors and the prize was won by Henry E. Rodriguez, Senior Civil Engineer. The officers of the Company who judged the essays reported that they all showed a high degree of merit and indicated care and good judgment in the selection and arrangement of the material. The prize essay is somewhat too long to be published in full here, but an abstract of it is given. A contest such as this is of value from several points of view and is worthy of consideration on the part of other industrial concerns. It seems to get a number of earnest students interested in the products and processes of the company in question, which is of advantage both to the company and to the student. It gives to the student a different sort of incentive from that of his ordinary college work, and makes him feel that he is more closely in touch with practical affairs.

Costs.—A prominent and active member of this Society has written the Editor on the subject of costs, a portion of which is herewith quoted:

"The province of technical publications of the Engineering Societies, so far as I know, is confined to papers and discussions other than Costs. Most engineers are concerned with the cost of construction, maintenance, equipment, depreciation, etc. An engineer may be quite well informed regarding the cost of certain classes of work and only imperfectly so regarding other classes. It is true when the occasion arises he will secure the information needed, more or less accurately, but quite often at an undue expense of time and effort. It seems to me that our journal could be made a valuable accessory of the estimators equipment if it would devote a section to construction news giving the cost of materials and labor and conditions affecting same, on the local market. Brief descriptions of work from those in charge, with data on quantities and costs, would be highly valuable.

"You will say that this field is already covered by 'Engineering-Contracting,' Gillette's and other Handbooks, etc. It is true in a way, but what I have in mind is something of a local nature. With ever changing costs it is not so easy to make a reliable estimate on the cost of a project outside of the particular line or lines in which one is especially interested. Such data published in our journal, in my opinion, would be valuable, though I fear it will never materialize, as it would necessitate the reporting of costs by members of the Society and considerable work on the part of the Editor."

It seems to the Editor a very excellent suggestion and he desires to state that he is perfectly willing to do his share of the work to further the plan. In fact, similar suggestions have been made by the Editor before this, but have met with no response, due most probably to the fact that men are so busy they have not the time to get such reports in shape. It might be worth while for the Board of Direction to appoint a special committee to take up this suggestion and determine the feasibility of putting it into operation.

The Military Engineer. The last regular meeting of the season was turned over to the Louisiana Section of the American Military Engineers, of which Mr. A. W. Shaw is president and Mr. E. Hunter Coleman, secretary. The general subject of the discussion was "The Army Engineer, a Rough and Ready Contractor." There was no formal paper, but a very interesting evening was spent listening to the experiences of a number of the members who had seen service in the various branches of the Army.

The first speaker was Lt. Col. Garsaud, who told of his experiences at Camp Pike as well as in France.

Mr. Thomas M. White gave an account of some of the technical and engineering methods used in handling the big guns of the Coast and Heavy Artillery.

Col. H. C. Newcomer, of the Regular Army, was detailed to Washington during the war, and told something of the methods of handling the army business from that point.

Major Jacques de Tarnowsky was connected with the Division of Forestry in France and related some very interesting experiences connected with that branch of the service.

Major W. B. Gregory was stationed at Tours, having charge of the installation of pumping plants and water supply for various base hospitals and other units, and he related a few of his experiences connected therewith.

Captain Hunter Coleman added an amusing sequel to the experiences of Col. Garsaud, telling one particular instance which the latter omitted in narrating his experiences.

Major Will S. Hutson illustrated the spirit of initiative and "go get it" of the American soldier by some interesting anecdotes about one of his officers, who had a special knack for getting hold of building materials when there were apparently none whatsoever in sight.

The discussion was closed by Major A. M. Shaw, who had charge of the construction of several large camps in the South and Southwest.

PAPERS AND DISCUSSIONS

CERTAIN FEATURES RELATING TO HYDRAULIC TURBINE DESIGN AND SETTINGS.

E. W. BURBANK.

Read before the Society May 9, 1921.

In days which only recently have passed, water power was developed in great part by the owners of the land on which the falls were located without entering into consultation with engineers. The installations as a result were mostly crude affairs and they have been rapidly abandoned. The water wheel has been replaced by the hydraulic turbine, and with the advent of the latter, there has been developed an art which is full of interest as well as complexities.

From a profession teeming with inaccuracies, there has come forward a profession which makes guarantees to the tenth of one per cent. I can recall the time when I was at college being told that a result in hydraulics within a few per cent of the true figure was accurate enough so that slide rule calculations would be sufficiently close. The day of slide rule calculations has not passed, but a hydraulic turbine engineer would not tolerate an error of as much as 1%, let alone the greater inaccuracies ignored in former days.

There has been a great deal of interest manifested by the majority of people in America with regard to the development of water power, which result is no doubt due to the long discussions in Congress for the past ten years, culminating in the passage in the year 1920 of a water-power bill which is expected to protect the rights of the people and yet give to the grantee of a license permitting of hydraulic development, a sufficient return on his investment to insure of making it a lucrative one.

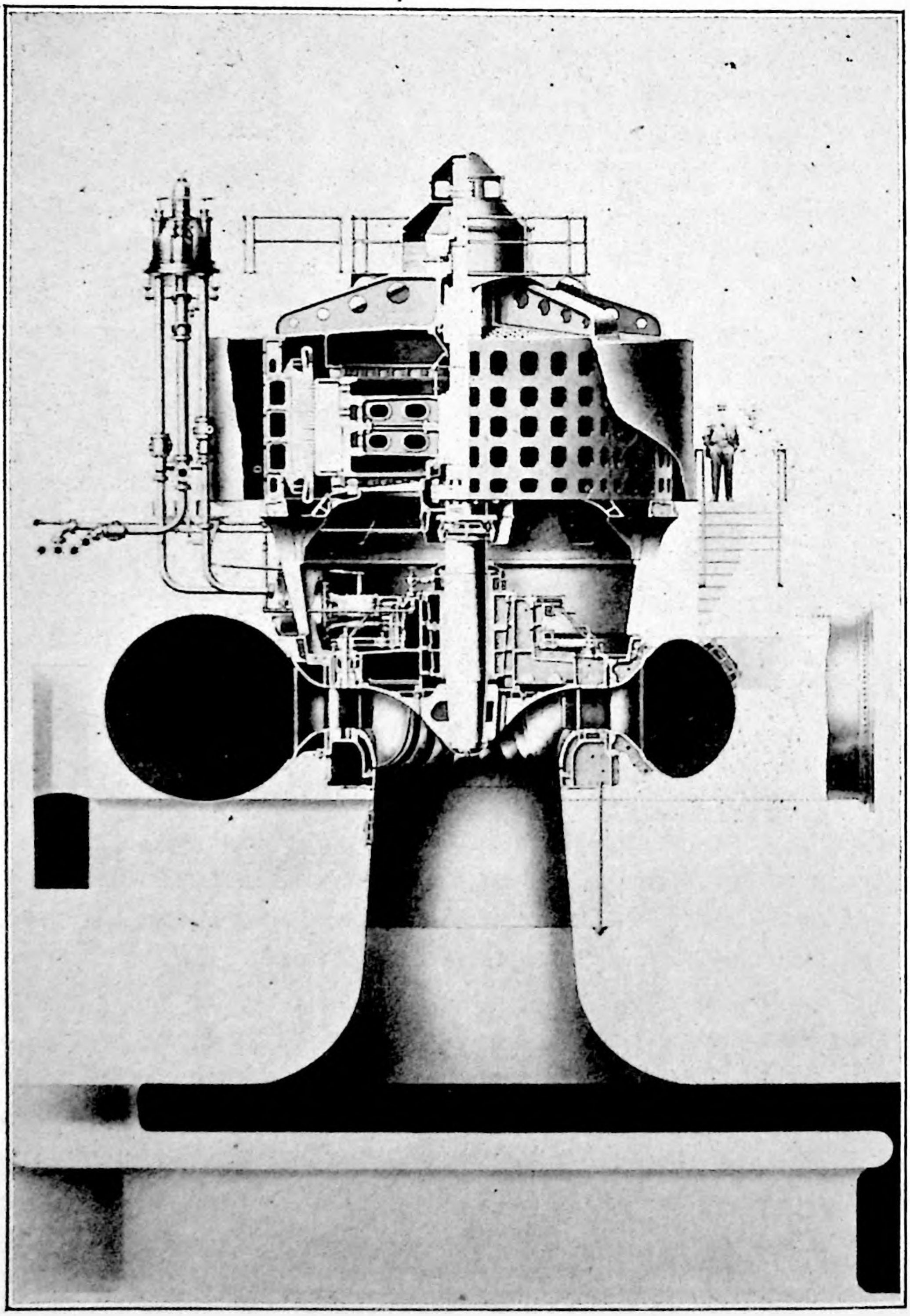
As a result of the passage of this bill, there is now open for development on both privately and publicly owned land, water power to the extent of approximately sixty million horse-power. Most of this power can be developed commercially. Already applications have been filed with the Federal Power Commission for permits to develop 14,000,000 horse-power. If the promoters' plans go through, the power will be developed within the next five to ten years, and there will be required a total capital conservatively estimated at eight billion dollars to carry these projects through to a conclusion. This amount not only covers the cost of the generating plants, but the cost of the transmission and distribution, together with the outlay for lamps, motors and appliances. As there is probably less than eight million horse-power in turbines developed up to the present time, we can see what an important future lies before the young hydraulic engineers, who will be graduated within the next decade.

The study of efficient water power development is one that will fill a good many volumes, and already there have been developed within the art specialists who function in only one particular phase, whether it be in the design of runners, the design of speed regulators, the design of regainers, the design of proper settings, the transmission of power, or other sub-divisions.

To proceed with the discussion of the purely technical features of the science would take me beyond my province, and make this paper uninteresting to many, but there are a number of features relating to the subject that will appeal to the majority of students, as these particular features enter into most discussions between engineers and representatives of prospective purchasers.

Turbines and pumps are very similar, in that the same hydraulic laws are used in their design, and the computation of their performance. The principal difference is in the application of these laws or principles. One often hears the remark made that a centrifugal pump is nothing but a hydraulic turbine run backward. That is true in a sense, but it is not true in that a centrifugal pump would ever be taken and placed in service for operation as a hydraulic turbine, although the same conditions of head and capacity might exist.

There are many kinds of turbines and many kinds of pumps, each kind designed to meet the special conditions to be imposed



The largest combined hydro electric unit in the world. 32,500 K. V. A., 12,000 volts 37,500 H. P., 150 R. P. M., 214 foot head. Built for the Niagara Falls Power Co., Niagara Falls, N. Y.

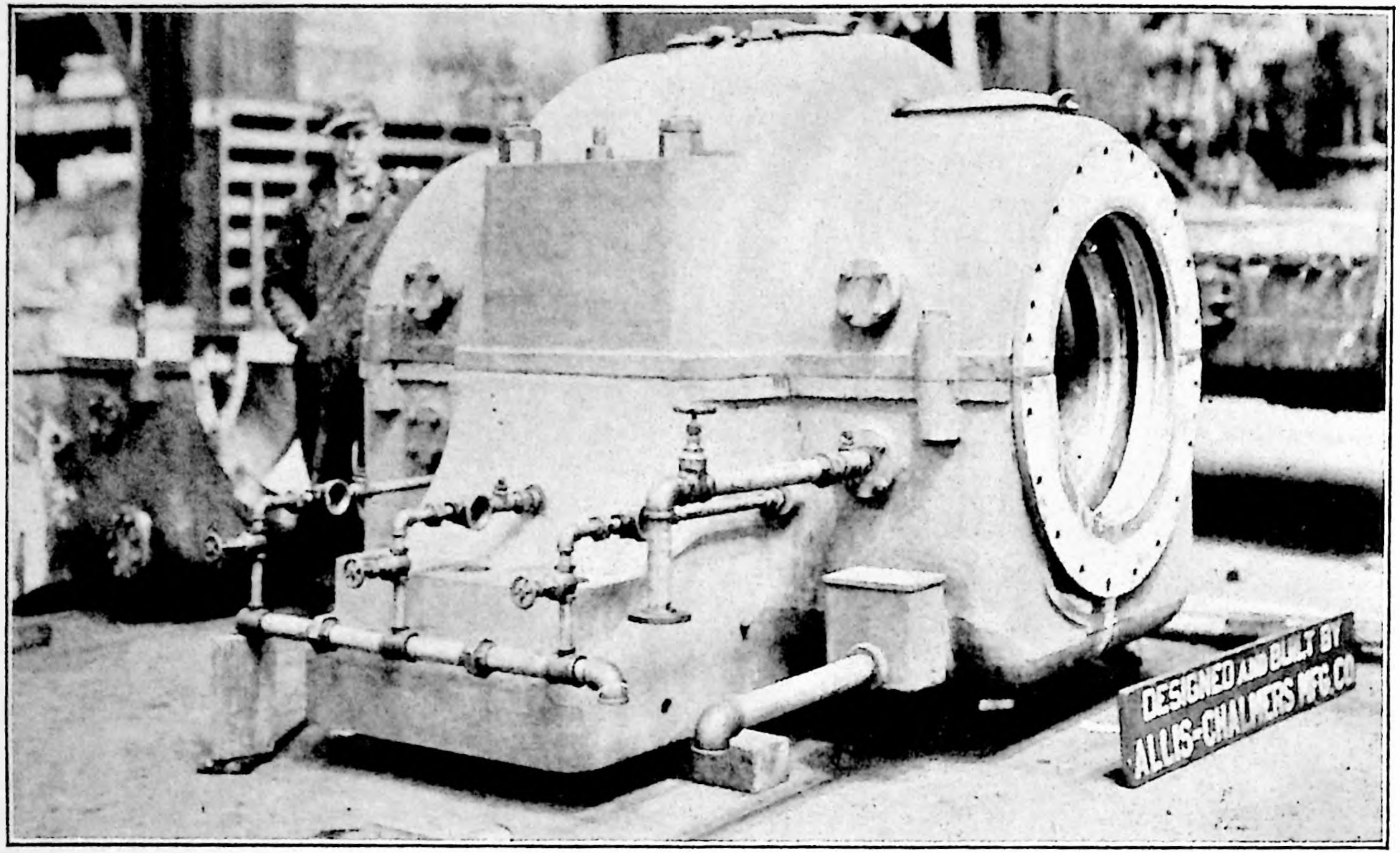
upon the unit. Before going into the matter further, let us consider some of the principal items that determine size and type.

First there is head, measured in feet and referred to by the symbol "H," then there is capacity or quantity in cubic feet per second expressed by the symbol "Q"—(in pump practice "Q"is usually given in gallons per minute) ;then there is speed, measured in revolutions per minute, and expressed by the symbol "N." Horse-power is expressed by the usual "HP," which takes into account the efficiency of the unit as expressed by the letter "E." Water horse-power does not take into consideration the efficiency of the unit, and is referred to as "WHP." Specific speed, about which we will have more to say later, in referred to by the symbol "N_s." "v" represents the spouting velocity equal to $\sqrt{2gh}$ "D" represents the runner mean diameter measured in inches. "u" is the ratio of the peripheral entrance velocity to the spouting velocity.

With head and capacity constant, the speed may be varied within limits by designs and selection of type. This is done, and designers to-day are endeavoring to obtain the highest commercial speed possible for fixed conditions of head and capacity without sacrificing efficiency to any great extent. If efficiency is sacrificed, it is because the loss in output is compensated for by the financial gain on account of smaller investment or more satisfactory and reliable operation obtained by fewer shutdown periods and less cost of repairs.

With capacity constant, then in a great measure, the type of the unit is determined by the head. From an engineering standpoint there is no reason why heads from 6 ft. to 6,500 ft. are not possible of development. From a commercial standpoint it may not be justifiable, because of the excessive cost due to construction of possibly a very large dam or a very long flume, tunnel or pipe line; also construction might not be undertaken if the power market was limited or the load factor exceedingly poor.

I just stated that from an engineering standpoint heads from 6 ft. to 6,000 ft. were possible of development. It is no



Bearing for 30,000 H. P. Impulse Turbine Units for Great Western Co.'s Caribou Plant, California.
Bearing is for 24¾" shaft, and shells are 72 inch long.

doubt inadvisable to make such a statement and hold ourselves within such limits. Only a few years ago, the lower limit of head for direct connected electrical units was about 12 ft., and the higher limit not much above 3,000 ft. So you see what we may be able to accomplish with difficulty to-day will be comparatively easy of accomplishment to-morrow, and such limits as confine us now will be swept aside.

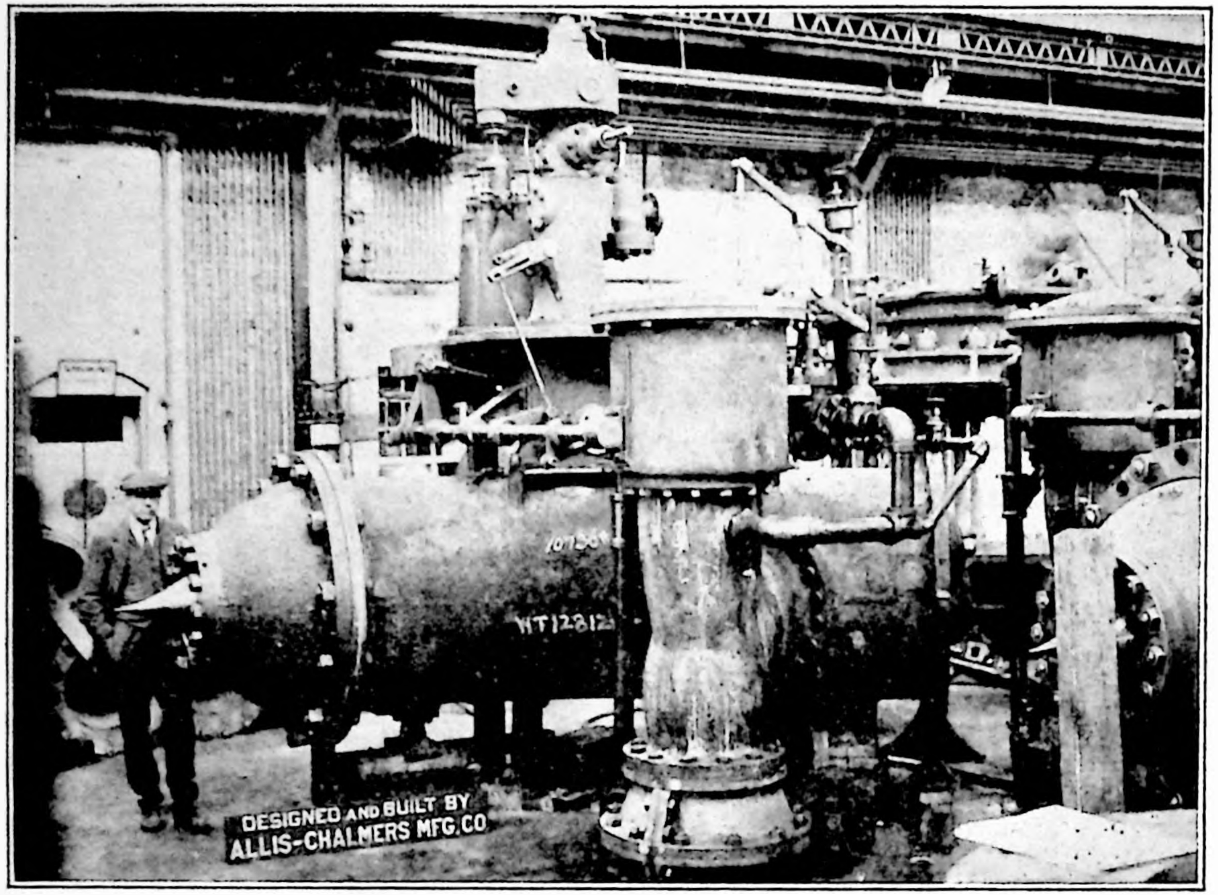
Head is important in determining type because design is influenced by the spouting velocity, and spouting velocity is determined by the head. There is a relationship between spouting velocity and revolutions per minute of a unit for constant diameter of runner, but this relationship is varied by the use of runners having either a smaller or a larger specific speed. Before going further, let me define what is meant by this term, as it is only by the aid of the term that a direct comparison of hydraulic turbine runners can be made.

Specific speed of a runner is the speed at which a model of the runner would rotate if same were homologously reduced in size so that it would develop only one horse-power when operating under a head of 1 ft.

Speed of a runner has become such an important matter of consideration for the reason that turbines and generators are very closely associated in engineering projects. For the same output, the higher the speed of a generator, the smaller its dimensions, and consequently the high speed unit can be built correspondingly cheaper than the lower speed unit.

It is only with the use of a high specific speed runner that low heads are commercially possible of development by obtaining a proper number of revolutions per minute to match a generator speed, and, contra, high head plants are only possible of development by the selection for use of a low specific speed runner. A 6 ft. head development would call for a specific speed runner of something like 160, whereas a 400 ft. head development would call for a specific speed runner of something like 20, and a 3,000 ft. head development would call for a runner having a specific speed as low as 3.

It is matters of this kind that give one commercial firm an advantage over another in developing low head plants. For



Assembly of Needle Regulating Nozzle, Pressure Regulator and Governor for 30,000 H. P. Impulse Turbine Units for Great Western Company's Caribou Plant, California.

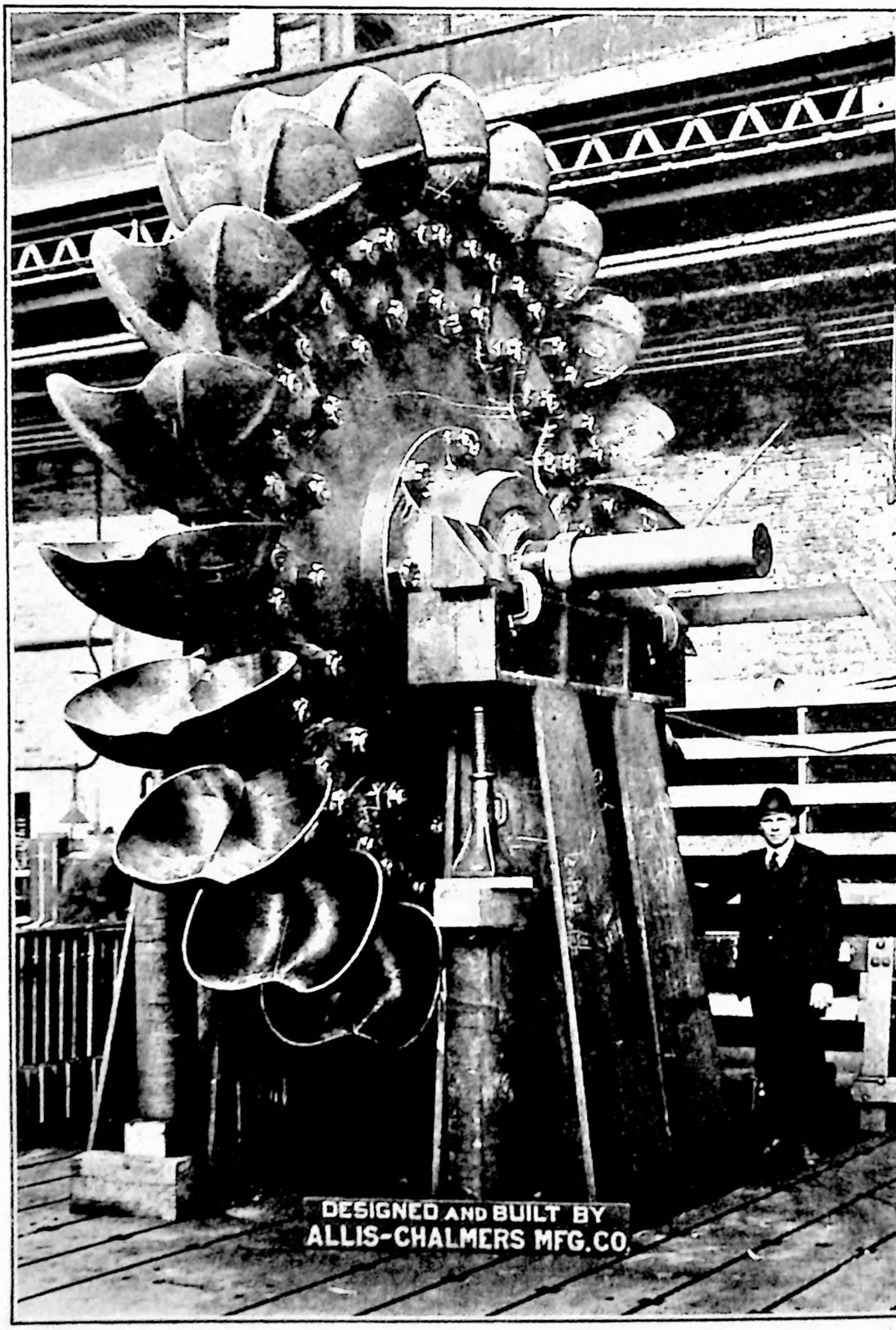
the same conditions, one firm may offer a unit with just as high an efficiency as another firm, but with a much lower speed. It is therefore easy to foresee which bidder is going to be low where equal grades of material and workmanship are offered. A great deal of interest and very keen rivalry is manifesting itself between runner designers, not only in America, but in Europe, as to who shall develop the highest specific speed runner.

I have neglected to state so far anything regarding limits of speed as influenced by the size or horse-power of the unit. To any engineering student it is reasonable to believe with other conditions equal, that units of low power should rotate at a higher speed in revolutions per minute than units of high power. Horse-power is directly proportional to the square of the runner diameter, whereas revolutions per minute are inversely proportional to the first power of the runner diameter.

The first thing to do in tackling a turbine problem is to calculate the approximate total water horse-power, and apportion this horse-power among the desired number of machines, and then reduce the various quantities to a unit basis. The water horse-power is equal to $\frac{H \times Q \times 62.5}{550}$ You are already familiar with this simple formula. In approximations we usually assume an efficiency of the unit of 80%, although large turbine units are manufactured to-day with an overall efficiency as high as 90%. Substituting 80% in the formula just cited or multiplying the water horse-power by 80%, the horse-power output is then equal to $\frac{H \times Q}{11}$, which is a very short and easy formula for every engineer to remember. A hydraulic engineer is very often called upon to give a quick approximation of the probable horse-power which can be developed, and with the aid of this simple formula and the slide rule, a ready answer is forthcoming.

The unit horsepower written "HP_1," is equal to $\frac{HP}{H\sqrt{H}}$.

The unit "Q" written "Q_1," is equal to $\frac{Q}{\sqrt{H}}$. The unit



Bucket Wheel for 30,000 H. P. units, built for Great Western Power Co.'s Plant, California. Weight of assembled wheel 25 tons.

speed, written "N_1," is equal to $\frac{N}{\sqrt{H}}$. Right here I want to caution in the use between the terms unit speed and specific speed. Unit speed of the turbine unit is determined without taking into account the horse-power of the runner, whereas the specific speed of the runner is calculated on the basis of the runner developing one horse-power.

The term "specific speed" is of European origin, and corresponding American terms are "runner characteristic" and "type characteristic," sometimes referred to simply as "characteristic." Specific speed or "N_s" is equal to the unit speed multiplied by the square root of the unit horse-power, which is also written $\frac{N}{\sqrt{H}} \times \sqrt{\frac{HP}{H\sqrt{H}}}$ which can be reduced to

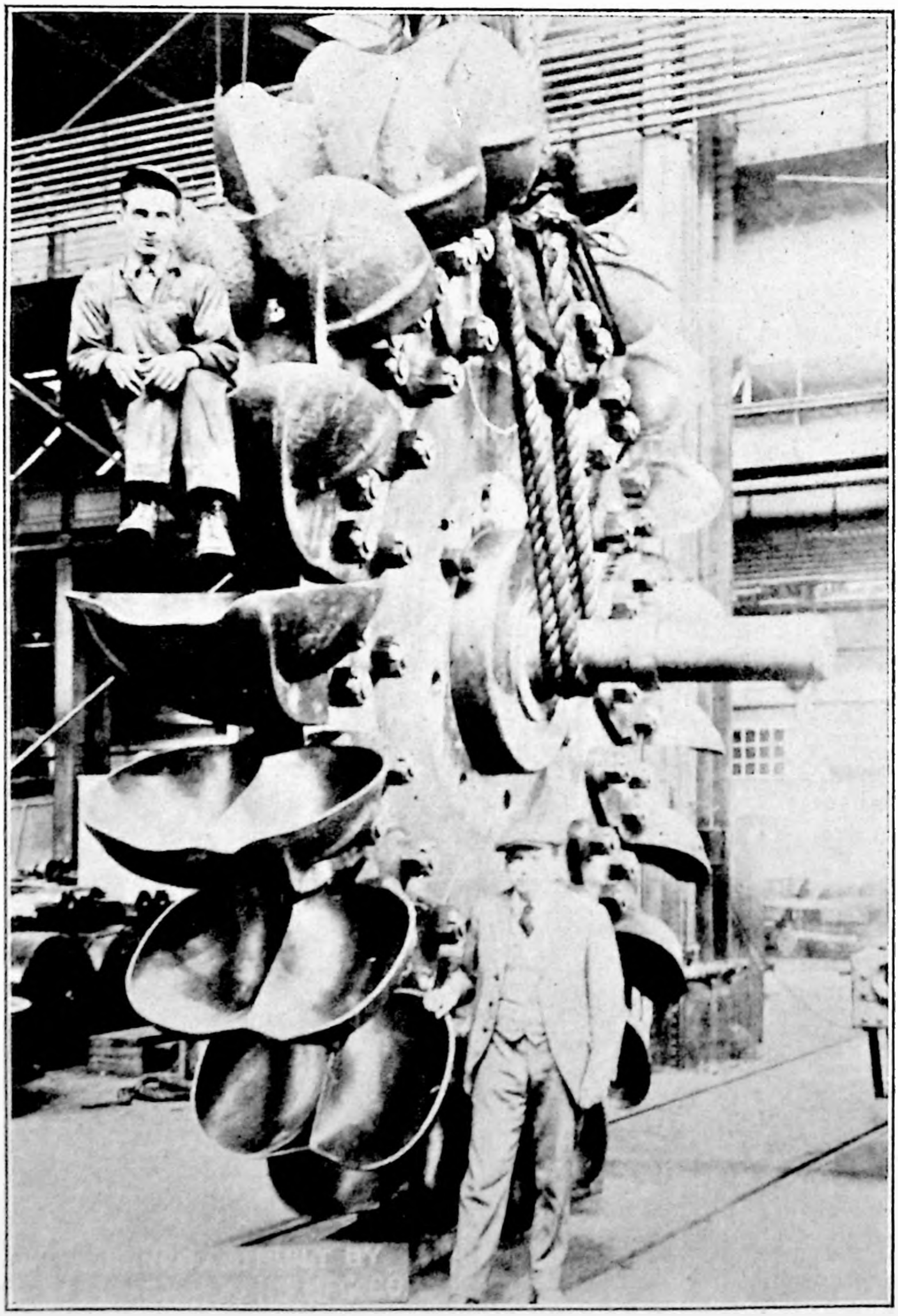
$$\frac{N\sqrt{HP}}{H^{5/4}}$$

"U" is equal to the peripheral speed at mean runner diameter in feet per second, divided by the spouting velocity or

$$\frac{\frac{WD}{12} \times \frac{N}{60}}{\sqrt{2gH}}$$ equals .000544 x D x N_1, or D equals $\frac{1840 \times u_1}{N_1}$

In selecting a certain type of runner to see whether it will fit the conditions to be developed, the value of u_1 is known. As the unit speed is possible of calculation, then the substitution of these values in the formula just cited, gives us the mean runner diameter in inches.

The value u_1, in impulse units, where the specific speed varies from one to seven, is approximately .45 or nearly one-half of the spouting velocity. In reaction turbines u_1 is equal to about 60% for a specific speed of 10, the value of u_1 increasing to about 85% for a specific speed of 100, and in the new axial flow turbine the peripheral coefficient is about 200%. It is because of this fact that it is necessary to run overspeed tests on generators to be driven by water turbines to find out whether they will withstand the higher stresses set up in the rotating parts should the turbine run away because of the load suddenly



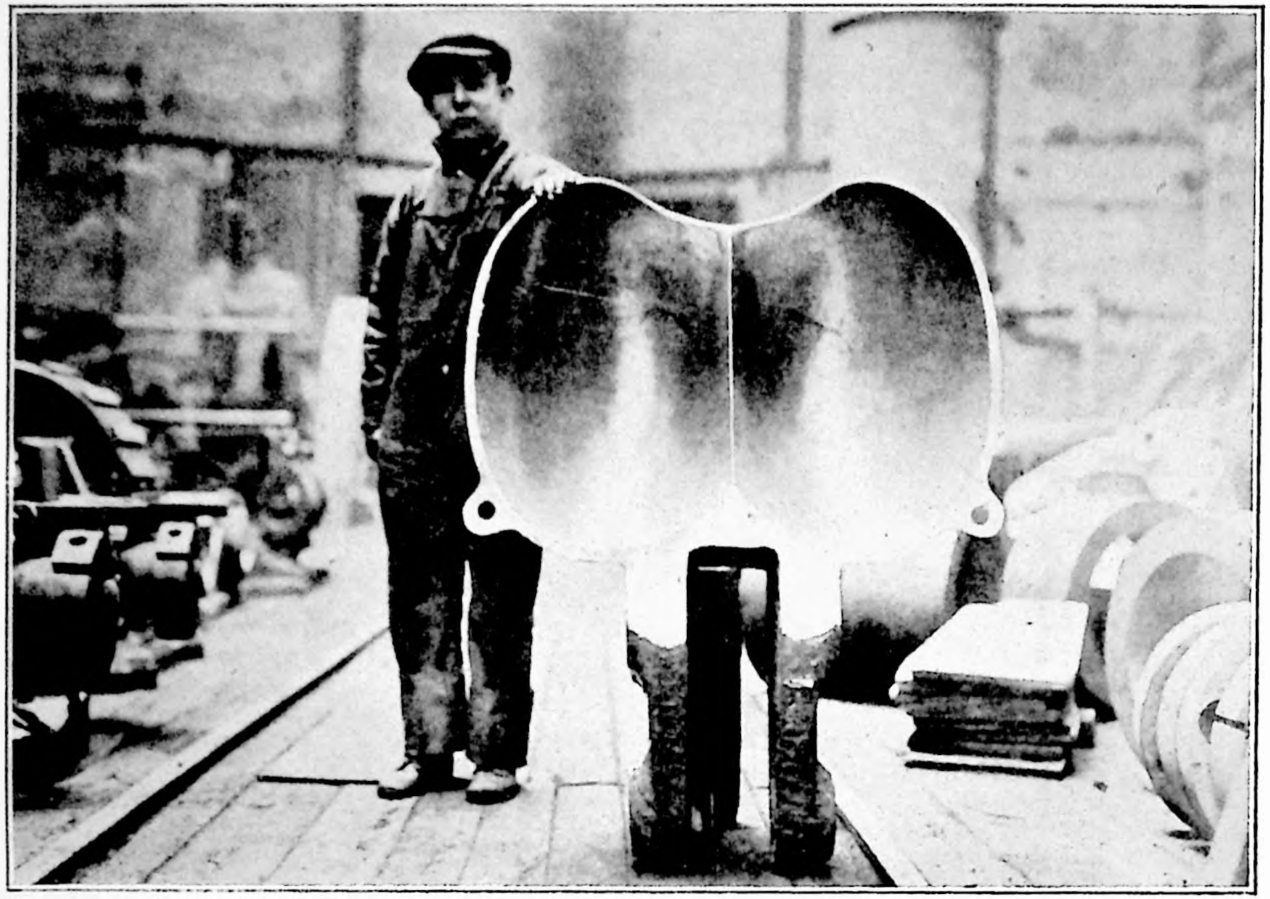
Bucket Wheel for 36,000 H. P. units, built for Great Western Power Co.'s Caribou Plant, California. Weight of assembled wheel 25 tons.

going off and inability of the governor to properly respond for some cause or other. The peripheral velocity of the impulse and mixed flow runners would in such an instance approach the value of the spouting velocity, while in the axial flow turbine the peripheral velocity approaches the value of twice the spouting velocity. Windage and friction losses keep the speed at runaway down below what it would otherwise be.

Although our runner experts are becoming more proficient all the time, and we are being constantly startled with new developments showing greatly increased specific speeds, higher efficiencies, much greater horse-power per runner, better speed regulations and other conditions very much improved, the time has not yet arrived when a turbine runner is designed for entirely new conditions in an important setting, and is installed in the power house without first building a model runner, usually about 30 inches in diameter and having an official test made of it in the Holyoke Testing Flume, Holyoke, Mass., in order to first see what the performance curves of the particular design of runner will show.

Such items as specific speed, ratio of peripheral to spouting velocity, unit quantity and unit speed are determined. If the quantities obtained are the desired quantities, or if the conclusion is reached that better results cannot at the moment be obtained, then the proposed runner for the turbine installation is "stepped up" in the various dimensions in the correct ratio to the dimensions of the test runner. It is sometimes the case that more than one test runner is designed and tested before the actual decision is made as to the characteristics of the runner for the new setting. However, it is not always necessary to have a test runner made for each new installation, for tests on some runner made during previous experimentation may show it to possess the characteristics desired.

Manufacturers have developed a line of runners which will meet the usual condition of head, capacity and speed, and many have put into their bulletins tables of sizes for various specific speed runners. From these tables, the unit quantity, unit speed and unit horse-power of certain runners can be obtained, which information will be sufficiently close for preliminary purposes.

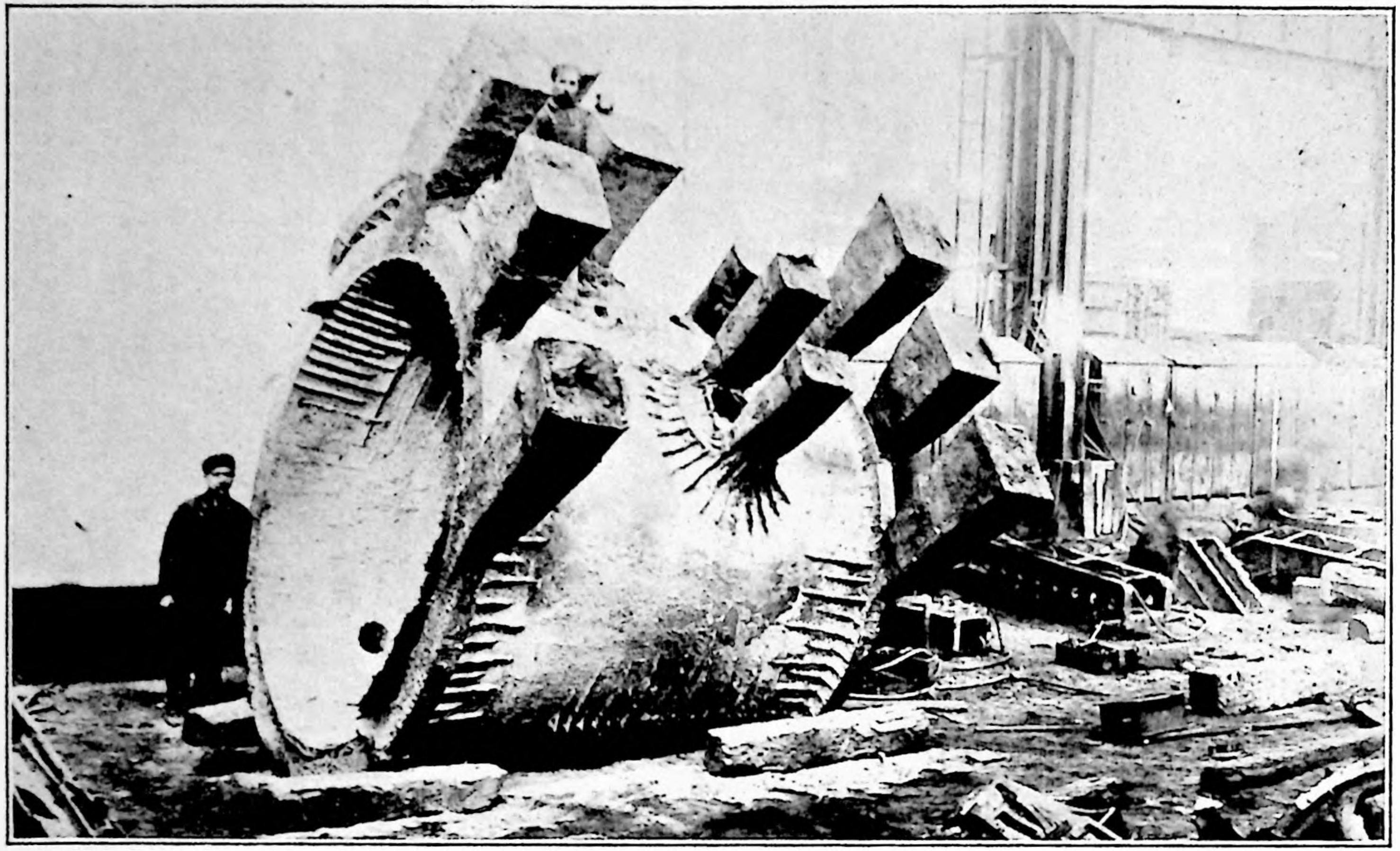


10 inch Cast Steel Impulse Bucket, measuring 36 inch across, weight 1,000 pounds. For the two largest Impulse Wheel Units in the World, 30,000 horse-power each, 171 RPM., 1,008 ft. head built for the Great Western Power Company, San Francisco, California.

There are two types of turbines built to-day, the impulse, or what is commonly known as the Pelton Wheel, and the reaction or pressure type of turbine. The impulse turbine consists essentially of a controlled nozzle in conjunction with a series of buckets mounted on a rotating disc. The jet of water discharges from the nozzles at the spouting velocity, and all the work on the buckets is done by the kinetic energy in the jet at zero pressure, as the buckets are not in the true sense of the word enclosed. There is a sheet metal casing over the turbine, but this is placed there as a means of safety, and to enclose the spray, thus eliminating in great measure the moisture which would condense in the power house, and in time give trouble to the generator windings.

The reaction turbine usually consists to-day of what is commonly known as the Francis type of runner, which runner is of the combined radial and axial flow type. The lower specific speeds of reaction turbines are secured when the runner is so designed that the flow through the runner is more radial than axial, while the higher specific speeds are obtainable when the runner is so designed that the flow through the runner is more axial than radial. We have the propeller type of runner with a specific speed at best efficiency of 160, which runner, as the name implies, more nearly resembles a propeller on a steamship than anything else, and the flow through this type is axial. This axial runner is used in connection with the standard wicket guides through which the water enters radially, but the cover plate of the turbine is so shaped as to deflect the entering stream so that it is practically flowing axially when it passes through the runner.

Impulse turbines consist usually of single discs, although in large horse-powers they consist of double discs. In either case, the discs are usually mounted directly on the generator shaft and overhung on the generator bearing. In this way it is not necessary to provide outboard bearings, but the generator bearings are specially designed to withstand the extra weights, and the impulse from the jet imposed upon them. By eliminating the extra bearings correct alignment of the unit is assured.



Steel Foundry view of inlet section of 9 inch inlet diameter Spiral Casing for one of the 40,000 H. P. Reaction Turbines now under construction for the Pacific Gas & Electric Co. These units will operate under the head of 421'.

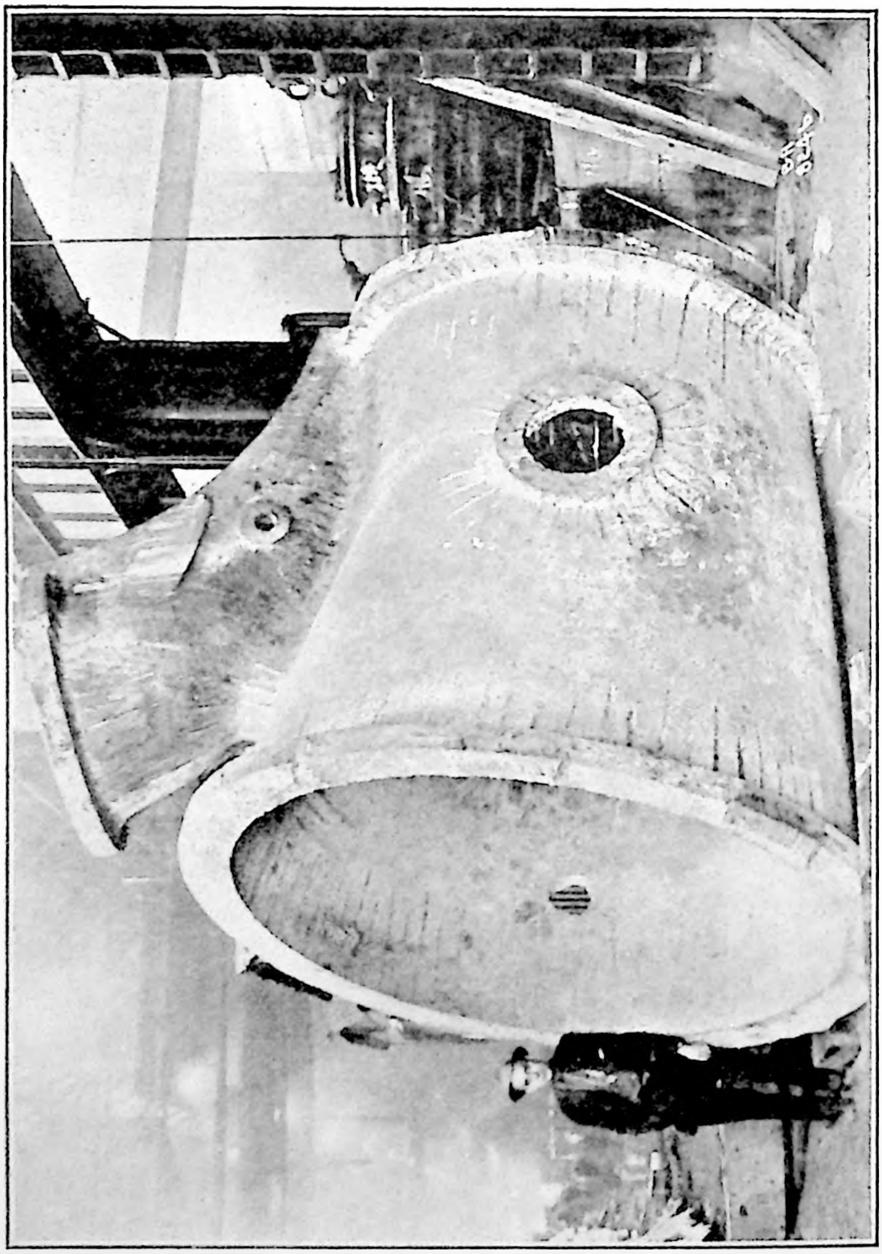
In the reaction type of turbines, there are as many as one to six runners, but the tendency nowadays is to concentrate the total power in a single runner. This comes as a direct result of the design of high specific speed runners giving the single runner turbine a relatively high RPM for low head developments. If the various losses are to be reduced to a minimum, the purchaser should install the largest single runner turbine for the conditions under development. This is made easy to-day due to the commercial advantages derived as a result of the interconnection of central stations. The factors of varying loan and of reserve do not enter into the problem as much today as they have in the past.

In low or medium head projects, the single runner turbines are usually set vertically, while in the high head reaction plants the runner is mounted on a horizontal shaft, and is usually of the single runner type, although with units of comparatively large horse-power, the double flow single runner is used.

This type of runner resembles the impellers in large double suction low head irrigation and drainage pumps. With such a runner, the hydraulic thrust is balanced, whereas in horizontal settings in high head plants, with one runner of the single flow type, a balance piston is necessary to equalize the hydraulic thrust, and thus provide for no lateral movement of the rotating parts.

In the vertical settings, the downward pressure, consisting of the hydraulic thrust and weight of the rotating parts, is carried on the upper or umbrella type generator housing by an oil-immersed step thrust bearing. In the very large vertical units and in some of the small ones as well, the Kingsbury type consisting of babbited shoes is used.

Although the tendency is to concentrate the total power of the unit in one runner, the multi single flow runner type of turbine is still found. These units are used a great deal in paper mill installations, where comparatively large horse-powers at relatively high unit speeds are required. These multi-runner turbines may consist of 2, 4 or 6 runners each, each set of two imposed one on the other and discharging into a common draft chest. In each set then one runner is right hand and the other



Machine Shop view of the same cast steel casing inlet section preceding.

left hand. I will have something to say later on with regard to the tendency to make changes in a number of these paper mill installations.

One of the real advantages in vertical low head plants with turbines direct connected to generators is that the generator can be set high enough to escape the high tail water during floor periods where the tail water elevation fluctuates through a wide range. It is usually not possible in such cases to permit of placing a horizontal unit high enough to escape the high tail water, for, during the dry seasons, the draft head would be greater than it would be feasible, or good engineering practice to impose on the unit.

Although a number of turbine installations have been completed only a comparatively short time, the development of the art has been so rapid that it is becoming common practice to replace equipment not yet worn out by machinery of the latest design. This is being done in order to obtain better efficiencies, increased power and a fewer number of working parts. Runner efficiency has not been raised to any remarkable extent during the last ten years, for efficiencies of 90% were recorded as far back as 1903. One thing which has been learned recently is the matter of a proper setting for the runner. It is safe to say that in most of the old water power plants, the overall efficiency can be increased by an amount equal to 15 to 40 per cent, and in extreme cases efficiencies have been doubled with the installation of modern machinery.

It is now possible to replace some of the twin and quadruplex units with a single runner, and some of the sextuplex units with two runners, high specific speed runners replacing runners of low specific speed type; and in making this replacement, it is possible to obtain the same total power with the same revolutions per minute at higher efficiency. The single runner turbine has of course only one-fourth the number of parts as the quadruplex runner turbine. This is a very important feature, as there are usually twenty guide vanes to the runner, and with the power divided into four runners, each of which is necessarily small, the guide vanes are lightly constructed and much more liable to break than with the larger and more rugged type of vanes used in connection with one runner of larger diameter developing the total horse-power. The smaller runners in the quadruplex units become clogged where there is considerable trash in the water, while this trouble is done away with in the replacement single runner while operating under the same conditions.

Sometimes the owner wishes to double his power output, but where the old flume is very much limited in size, this is not possible of attainment because of resulting flume velocities. A flume of certain dimensions has a definite limit of capacity beyond which the higher water velocities and disturbances induced thereby increases rapidly and largely offsets the extra flow. Usually the flume velocities should not exceed 10% of the spouting velocity, and better practice is to keep this value down to between 7 and 8 per cent. For 9 ft. head development, the flume velocity should be about 2 ft. per second, whereas in 25 ft. head developments, a 3 ft. flume velocity would be satisfactory.

Before one can finally decide upon the general type of turbine that is to be installed, that is, whether it is to be a horizontal or vertical setting and consist of either one, two, four or six runners per shaft, it is well to know the character of the casing which could be employed and the limitations placed on each type.

First, let us consider the setting where there is no casing at all—these are called open flume settings. The turbine may be set either horizontally or vertically. The head for this setting may be anywhere from several feet to 50 feet. Where the water must be conducted in a closed flume from fore-bay to the power house then the open flume setting is out of the question, and the runner should be enclosed in either a spiral or cylindrical casing. If the unit is of the two-runner type, the plate steel cylindrical casing is generally used and the unit is horizontal. Best efficiencies can not be secured with this type of casing though, and where best efficiency must be maintained it is necessary to place each of the runners in a separate spiral casing. In most instances it is found advisable to set a single runner vertically and form a spiral casing around it in concrete. The heads for such units are within the upper limits of open flume settings, but it is rare when this arrangement is resorted to for heads less than 20 feet.

For heads between 50 feet and the upper limit of head of the reaction type of turbine, say 800 feet, cast iron spiral casings are sometimes used. This is true where the amount of water is not very great and dangers from water hammer are slight. Where the volume of water assumes larger proportions, and also in cases where high stresses might result due to water hammer, a substitute for cast iron casing is made, using a casing of either plate steel or cast steel material. Plate steel spiral casings are becoming very popular for heads up to 250 feet, and cast steel for the higher heads. The limit of head for developments where the plate steel casing is used is being constantly extended upward.

Only recently a unit with a plate steel spiral casing has been constructed for the San Jaquin Power Company to operate under a head as high as 240 feet and develop 12,000 HP in one runner. One advantage of this type of casing is that it eliminates the cost of expensive patterns, and another advantage is that the parts can be easily transported; it can be made of larger inlet diameter than cast casings for the same cost, and thus maintain a lower casing velocity, thereby reducing the friction and guide case entrance losses. Plate steel casings are made with an inlet diameter as large as 15 feet, and casings of this material should certainly be used where the casing inlet is eight feet in diameter or larger.

We have been referring to the various head limits for different types of runner casings, but these limits are not limited in a true sense, as it is necessary in some instances, due to local conditions which are not general, to resort to a type of setting which would otherwise not be standard for such developments. I can recall an open flume setting of 70 feet where the units are vertical and rated 9000 HP in three runners. Had this plant been designed only recently, a single high specific speed runner would no doubt be used in a vertical setting with a plate steel spiral casing and discharging into a White hydraucone regainer, the latter substituted for the usual type of draft tube.

The effective head acting on the runner or runners of a hydraulic turbine is the head on the runner on the upstream side less the back pressure on the down stream side of the runner. The purpose of the draft tube is to increase the value of the effective head by decreasing the amount of back pressure on the runner discharge. In the early stages of the art, little thought was given to the energy in the water thrown away from the runner. Turbines were set above tail water level and the discharge was directly into the atmosphere, possibly several feet above tail water elevation. Different forms of draft tubes were then designed, some short, some long, some straight, and some flared. The straight flared tube, with an angle of about 11 degrees between the sides has proved to give excellent results. You can readily see, however, that the straight draft tube can only be used in small vertical units.

Water discharged from a runner vertically downward must have its direction of flow changed to the horizontal in order for it to flow away from the tube outlet. By changing the direction of the flow in as smooth a manner as possible the discharged water is prevented from piling up in the tail race and causing loss of effective head on the turbine. This change of direction is usually accomplished by taking the straight flared tube and curving it through 90 degrees the longer the radius within limits the better the results obtained. In high head plants the engineer is not restricted in the length of the curve, but in low head plants the head restricts this length, for the runner must be set sufficiently below the low head water elevation in order that air will not be entrained with the water entering the runner, thus causing considerable loss in efficiency due to this air breaking the draft head. In setting the runner down there is not usually very much vertical distance left in which to form the draft tube and get a regain of energy in the form of head, and to change the direction of the flow from the vertical to the horizontal.

Turbines have been installed which have operated satisfactorily with draft heads as great as from 18 to 24 feet. Long draft heads do not always give the best results for fluctuations in load conditions cause oscillation of the column of water in the draft tube, giving considerable governing trouble and causing vibration of the unit.

It is not always possible to excavate the tail race sufficiently at the turbine discharge to permit the placing of anything like a good design of draft tube with a constantly enlarged cross section and easy curve. As a result the low head turbine draft tubes are so modified from what would be the correct design that very little regain of energy is secured. In some plants the regain is so small that it seems unnecessary to go to considerable expense to construct an elaborate tube formed in concrete.

In the latest designs of turbines, the energy in the water discharged from the runner may be from 4 to 20 per cent. of the total water horse-power. In the best form of curved tubes the energy regained is somewhere near 40%. In the majority of low head plants the regain is probably less than 25% Considering the case where the maximum of the energy is thrown away the unit with a 40% tube would have 3% greater efficiency than if equipped with a 25% tube.

Many turbine contracts carry a bonus and penalty clause which allows the turbine manufacturer an extra payment of a stipulated amount for each per cent. or fraction thereof that the guarantees are exceeded. Likewise a penalty of the same amount is exacted of the manufacturer for each percentage or fraction thereof in efficiency that the turbine lacks meeting the guarantees. In a contract entered into between St. Lawrence River Power Company and the Allis-Chalmers Mfg. Co., there was inclued a bonus and penalty clause calling for the payment of $6,000.00 per unit for each per cent. that the efficiency exceeded or failed to meet the guaranteed amount. A bonus of $50,000.00 was actually paid to the manufacturer of the four units because of the higher efficiency turbines furnished. A difference, then, of 1% in the total efficiency of a turbine unit means considerable to both the manufacturer and the purchaser, especially where several units are being installed. It is often the case where large units are considered to value a per cent. in efficiency either above or below the guaranteed amount of $5,000.00 per unit, and it is my personal opinion that as years go on this amount will increase. It behooves every manufacturer of hydraulic turbines to develop designs of draft tubes which can be used in connection with units which he manufactures which will give as high a total unit efficiency as possible, for the day is passing when orders are placed for units having only a high runner efficiency without taking into consideration the efficiency of the setting, including the draft tube. The purchaser has come to realize the advantage of a combined bid placing the entire responsibility upon one party, and contracts are now being awarded to bidders who can guarantee the greatest amount of kilowatts at the switchboard with the least amount of water passing through the turbine.

One of the most remarkable of recent developments in the nature of regainers is White's patented Hydraucone regainer, such as is at present installed as part of unit No. 16 of the Niagara Falls Power Company. This regainer has an efficiency of approximately 80%, which means twice as much regain in energy over the best form of curved draft tube. The percentage of total energy discharged from the runner in a low head plant is much greater than the percentage of total energy discharged from a runner in a high head plant, so that it is only in low head plants that there is such a marked increase in the total efficiency of the unit resulting in the installation of the hydraucone regainer.

Again considering the case where 20% of the total head is thrown away from the runner, the hydraucone regainer, if used, would increase the efficiency of the unit by 8% over the unit efficiency with the best form of curved draft tube.

The regainer, due to its form, is more perfectly adapted to the low head plants than any other type of regainer because of the relatively short vertical distance occupied by the regainer, making it unnecessary in most instances to excavate the tail race below the turbine unit. A turbine unit with this type of regainer may cost more than a turbine unit with a different type of regainer, but when one considers the great gain in efficiency and the lowered cost of the power house construction and tail race excavation, the advantage is all in favor of the high priced unit.

This difference in efficiency between various types of draft tubes is due to the fact that the water entering the tube from the runner at high velocity, fills the tube at this point and although the draft tube increases in cross section, the jet of water does not expand and fill the tube with a corresponding slowing down of the velocity. The jet adheres to the lower side of the tube and at the end is discharged at comparatively high velocity. Because of this action, the upper or short radius side of the curved draft tube is not being used to slow down the velocity. This section would, if there were no difference in pressure, be filled with dead water, but because of the difference in pressure water from the tail race enters the upper side of the tube at its short radius and flows out with the high velocity jet on the lower side of the tube.

As velocity head is gradually transformed to pressure head throughout the length of the draft tube, it is readily seen that the point of lowest pressure is at the runner discharge, and with other conditions remaining equal, the tube giving the lowest absolute pressure at this point is the one that is most efficient. When water enters the curved tube from the tail race in the method just described, the low pressure at the throat is cut down and the effective head on the runner correspondingly decreased.

There are so many problems which arise relating to the satisfactory solving of the various problems in connection with the efficient development of a water fall that a paper of this length can not do justice to any particular phase. I have onl yattempted to touch on the high points, and if there are any of you who are following hydraulics as a profession, I would recommend your reading the various papers which have lately been published dealing with certain vital parts of this subject. There is probably no other branch of science which is as full of romance, or which holds the student with such absorbing interest.

vide p. 149

WOOD PRESERVATION.

By HENRY E. RODRIGUEZ.

Abstract of prize-winning essay in contest for students held by Creosoted Material Company.

While the available records of ancient times show that the art of preserving organic bodies against decay, and the protection of timber from attacks by worms, were known and practiced as far back as the period in which Pliny lived (23 to 72 A. D), and that various forms of preservation were used by the early Egyptians, Greeks, Britons, Dutch and Burmese, the preservation of woods by the injection of preservative liquids did not become scientific in principle until early in the nineteenth century. Many authentic records, however, showing the gradual development of the art of preservation of timber, are available covering the period from 1657 to 1838, in which latter years Bethell patented a process for using coal tar creosote, which was injected into the wood under pressure in a cylinder. It was, also, in the year 1838 that the first crossties were treated in the United States for use on the Northern Central Railroad in Maryland, now a part of the Pennsylvania System. It can well be stated here that the railroads gave the creosoting industry its first impetus. Previous to 1838, Kyan had patented the injection of a preservative into wood by pressure in a closed cylinder in 1832, and Moll had patented a process for treating wood with coal tar creosote in a closed iron vessel in 1836. In 1848 wood preservation was first started on a commercial scale in the United States at Lowell, Mass., and has continued to develop until this present day.

Though wood is, perhaps, the most widely used material, it has one serious drawback, for if exposed to the weather, or placed in contact with the soil, it will last but a comparatively few years. No substance, of course, will last forever; even stone and steel will crumble and corrode with time. But the life of wood in its natural state, even at the longest, falls far short of that of other structural materials. Yet, wood is made to serve so many purposes, and is so peculiarly adapted to certain uses for which no real substitute has been found, that the problem of how best to prolong its life in service is of the first importance.

One very great advantage which wood has over other materials is its comparative cheapness. This advantage, however, has been growing steadily less, as the cost of wood has mounted higher and higher. To timber a mine, to build a fence, or to lay a railroad track, with the woods best suited to each, costs in many cases four times as much as it did twenty-five years ago. Naturally, the tendency has been to discontinue the use of the better woods, which have steadily grown scarcer and more expensive, and to substitute inferior ones, with only their cheapness and availability to recommend them. Thus, with the high cost and scarcity of the better woods, and with the exceedingly short life of the cheaper ones, the user faces a serious condition. To meet it, if wood is to remain a cheap material, its life must be prolonged by the use of chemical preservatives.

Wood preservation, by prolonging the life of timber, does more, however, than to justify the cost of expensive woods or permit the use of cheaper ones. It gives the user a much wider field for the selection of his material than he otherwise would have. Woods which were once considered worthless can be treated and made to last practically as long as any others.

The cause of decay in wood is the action of the low forms of plant life called fungi and bacteria. These produce dust-like spores, which are wafted through the air and into cracks and season checks of sound timber. When favorable conditions exist, these soon sprout, sending into the wood film-like threads or roots, which furnish food to the fungi by consuming certain organic substances in the wood. Crumbling of wood is the result, which is known as rot or ordinary decay, depending upon the species of the fungus or bacteria attacking the wood. Decay is practically a "contagious disease of wood." Some woods are disinfected against decay by nature. A few of these are teak, red cedar, walnut and Osage orange.

By far the best method of checking the growth of fungi, however, is to poison their food supply. This can be done by injecting poisonous substances into the timber and so changing the organic matter from foods suitable for fungi into powerful fungicides. It is a mistake to suppose that the germs of decay are inherent in the wood, and only need an opportunity for development to bring about its destruction. Several processes for the preservation of wood have been founded on the false assumption that it is necessary to destroy the "germs" in the interior of the timber. That impression, doubtless, arose from the fact that after a stick of timber begins to rot it is impossible to tell just where the fungus spores germinated and carried entrance into the timber. Moreover, the fact that the heartwood of the tree may have become infected before felling, or that the interior of a stick of timber may have reached an advanced stage of decay before there are any external evidences of the fungi,—such as fruiting bodies, or films of mycelium—tends to convince the casual observer that decay starts from the interior. Yet the wood-destroying agencies start from the outside. If the interior is sound, this explains the efficiency of certain paints which merely form a superficial coating over the surface of the timber, but which are poisonous enough to prevent the spores from germinating, or the hyphal of most forms of wood-destroying fungi from penetrating into the unprotected wood in the interior. The ancients were in the habit of painting their statues with oily and bituminous preparations to preserve them from decay. The great wooden statue of Diana at Ephesus, which was supposed to have descended miraculously from Heaven, was protected from earthly decay by oil of nard. Pettigrew extracted the preservative fluids from the heart of an Egyptian mummy that had resisted decay for over three thousand years, and found that decomposition immediately set in. This showed that it was the presence of the antiseptics which prevented decay, and not a chemical change of the tissues.

The preparation of timber for its preservative treatment is an important factor in the finished product. Only sound wood is fit for treatment. If decay has made a start, it is not always entirely stopped by the treatment, but may continue beneath the treated wood until the interior of the post is destroyed. The first thing to consider, then, is the selection and preparation of the timber.

All timber should be peeled and thoroughly seasoned before the preservative is applied. In peeling timber (pine, cedar and other coniferous woods), care should be taken to remove the thin inner bark from the part of the post that is to be treated. Even small patches of this bark often prevent penetration by the preservative. When the bark drops off, a patch of untreated or poorly treated wood is exposed, and the opportunity is offered for decay to enter. The effectiveness of the treatment depends on maintaining an unbroken area of treated wood entirely around the post. In some of the hardwood strips of bark do not retard penetration so seriously.

There are five chief requirements for a preservative for general use. It should be reasonably cheap, should penetrate wood rapidly, should not be corrosive to metal, should not evaporate or wash out of the wood easily, and should be poisonous to fungi.

Of the many antiseptics which have been prposed for the preservation of timber, only four have been largely used with success in the United States. These are creosote (dead oil of tar), zinc chloride, corrosive sublimate (bichloride of mercury), and copper sulphate. At the present time copper sulphate has fallen into almost total disuse, and corrosive sublimate is the so-called "Kyanizing" process, which is so frequently referred to in all the literature of wood preservation. In general, the process consists in steeping the timber in a dilute solution of corrosive sublimate long enough to insure thorough penetration.

In the United States creosote and zinc chloride are the only preservatives in common use. There are many patented preservatives known by various names, but most of them have for their base one or the other of these two preservatives. Creosote is a by-product of coal tar, which is produced at most plants for the manufacture of illuminating gas and at by-product coke-oven plants. Coal is heated in a retort from which air is excluded. The gases produced are driven off and collected, the lighter ones first and progressively heavier ones as the heat of the distillation increases.

Both creosote and zinc chloride are excellent antiseptics. Creosote's principal point of superiority, however, lies in its insolubility in water. Once it is injected into timber it wll not wash out, no matter how wet may be the situation in which the treated timber is placed. Zinc chloride is much cheaper than creosote, and since it is shipped in the form of a solid, the freight charges are considerably less. But zinc chloride is soluble in water, is, in fact, injected into the timber in water solution, and when timber treated with it is exposed to moisture the leaching out of the salt is only a question of time. Hence, zinc chloride is most commonly used in comparatively dry situations. Creosote, on the other hand, is used where the timber will be subjected to moisture. Moreover, creosote is one of the very few preservatives in use which offers effective protection against the marine borers, which work such havoc among the wharves of the Atlantic, Gulf and Pacific coasts. Since it is insoluble in water, it cannot wash out of the piles, if properly injected, and since it is more than a mere external coating, there is no danger of its being broken off by floating debris.

Only a few of the large number of water-soluble preservatives have proven of any value after having been tested. Most of them are either not sufficiently toxic against fungi or form reactions with the wood which tends to destroy the strength of the wood. This latter is particularly the case with iron sulphate and chemicals strongly alkaline. Of the many water-soluble preservatives tested, copper sulphate, mercuric chloride, sodium flouride and zinc chloride have given best results.

A summary of a few of the objections to certain wood preservatives are as follows:

As nearly all wood preserving plants are built of steel cylinders any preservative which attacks steel cannot, of course, be used in them. This excludes such preservatives as mercuric chloride, copper sulphate, etc., from standard practice.

The effect of the preservative in the wood upon the inflammability of the wood is also an important consideration, particularly in mines, bridges and dwellings.

The processes by which the preservatives are injected into the timber may be divided into two general classes, "the pressure processes" and the "non-pressure processes." The latter term is somewhat misleading, for it implies that no pressure at all is employed. This is inaccurate, for with the exception of "Kyanizing," "dipping," and the "brush treatments," pressure in some form is used in all wood-preserving processes. The essential difference between the pressure and the non-pressure processes is that in the former the pressure is applied by force pumps, compressed air, or similar means, while in the latter atmospheric pressure alone is relied on.

Each of these classes may be further subdivided into the "full cell" and "empty cell" processes. Some processes, both "pressure" and "non-pressure," force the preservative into the wood so as to fill the cells and intercellular spaces; hence, they are known as the "full-cell" processes, and the result is the "full-cell treatment." The aim of the other processes is merely to leave a film of the preservative around the cell walls, and, hence, either smaller amounts of the preservative are forced into the wood or else the superfluous oil is extracted after the penetration has been assured. Sometimes a combination of these two methods is employed. Needless to say, the "empty-cell" treatment is the cheapest, other things being equal; and though this is sometimes not its only advantage, it has been the chief factor in extending its use.

Until very recently, the pressure processes were used in this country practically to the exclusion of all others. In England and on the Continent they are still almost universally employed.

The two most widely used processes are the "Bethell" and "Burnettizing." They differ only in the preservative. In the "Bethell" process creosote is used and in the "Burnettizing" zinc chloride. The method of injecting the preservative into the timber is, in each case, practically the same. These two processes have long been accepted as standard, both in this country and in Europe, and they may serve as a basis for comparing the numerous adaptations which have been devised.

The timber to be treated is placed on iron trucks, or "cylinder buggies," and run into hugh horizontal cylinders, some of which are 8 or even 9 feet in diameter, and more than 150 feet long. These are capable of withstanding high pressure, and their doors are so arranged that, after the timber is drawn in, they can be closed and hermetically sealed.

After the doors are closed live steam is admitted into the cylinder, and a pressure of about 20 pounds per square inch is maintained for several hours. In some cases, the steam pressure is allowed to go considerably above 20 pounds, but this brings constant risk of injuring the strength of the timber. When the steam is at last blown out of the cylinder, the vacuum pumps are started, and as much of the air and moisture as possible is exhausted from the cylinder and from the wood structure. This process also continues for several hours. Finally, after the completion of the vacuum period, the preservative is run into the cylinder at a temperature of about 160-F., and the pressure pumps are started and continued until the desired amount of preservative is forced into the wood. The surplus preservative is then blown back into the storage tanks, the timber is allowed to drip for a few minutes, and finally the cylinder doors are opened and the treated timber is withdrawn.

Rueping Process—Most widely known as "empty cell" process. Used only with creosote in both Europe and America. Wood is air-dried before being placed into treating cylinder. Air is forced into the cylinder at 75 pounds pressure after sealing cylinder, thus filling the space in the interior of the structure of the wood with compressed air. Still maintaining this pressure, the oil is forced into the treating cylinder at a somewhat stronger pressure, say 80 to 85 pounds, and after the timber is all covered by the preservative the pressure is increased to about 225 pounds. This forces oil to penetrate into the interior of the timber. Valves finally opened, and the surplus oil is run back into the receiving tanks. This, of course, relieves the pressure around the timber, and the expansive force of the compressed air in the interior of the wood, sometimes strengthened by a vacuum drawn in the treating cylinder, forces out much of the oil, leaving merely a coating around the cell walls. A comparatively deep penetration, with a light absorption, is thus secured.

Care should be exercised in handling treated timber to see that the treated wood is not scraped away and untreated wood exposed. If such an accident does occur, the exposed untreated wood should be given two or three coats of hot creosote. Treated timber should never be cut if it can be avoided. All sawing and framing should be done, if possible, before treatment. If it is necessary to saw after treatment the exposed untreated wood should be painted with creosote before it is put in place.

With the signing of the armistice, the demand for creosote for war purposes ceased. This diverted to commercial use a large quantity of oil which, during the war, was taken over by the Government. As evidence of this fact, the consumption of creosote, by the wood preserving industry in 1919, increased by 12,779,861 gallons. In addition, the importation of foreign oil rose from 1,545,247 gallons in 1918 to 11,268,379 gallons in 1919. The largest quantity of zinc chloride ever before consumed by the industry in any previous year was reported in 1919 and amounted to 43,483,134 pounds, an increase of 12,-382,023 pounds over the quantity in 1918.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

REGULAR MEETING OF THE BOARD OF DIRECTION, JUNE 13, 1921.

Meeting was called to order with Mr. Manley in the chair and Messrs. Barelli, Lawes and Robert present.

Ballots for new members were opened, there being 70 formal and 1 informal cast, and as a result the following were elected to the respective grades of membership:

Resident Members—Joseph B. Converse, Daniel S. Elliott, Herbert M. Gallagher.

Transfer from Student to Resident Membership—Ralph H. Mann.

The membership of Mr. James R. Adams was changed from Resident to Non-Resident grade, to take effect July 1, 1921.

A letter from the Panama-Pacific International Exposition was read offering the Library a History of the Exposition for $30.00. Upon motion, duly seconded, it was decided not to purchase this history.

A letter from the New Orleans Building Louisiana State Fair asking for permission to pay the contractor money due him out of money in the Treasury, was read and the Secretary was instructed to authorize the payment of this money as per their letter of May 25, 1921.

A letter from the Engineers and Architects ' Club of Louisville, Ky., and also one from the Engineers' Club of Seattle, Washington, asking for exchange privileges, was read, and upon motion, duly seconded, exchange privileges were granted both of these clubs.

A letter from the Highways Information Service was read asking to be placed on our mailing list, and upon motion, duly seconded, it was decided to place them on our mailing list without any obligation for continuance.

The report of the Secretary was read and approved and the bills ordered paid.

There being no further business, the meeting was adjourned.

JAMES M. ROBERT, Secretary.

REGULAR MEETING OF THE SOCIETY, JUNE 13, 1921.

The regular meeting of the Society was called to order with President Manley in the chair and 40 members and guests present.

Mr. G. W. Lawes introduced the following resolution for the first reading:

WHEREAS, An ordinance has been passed by the Constitutional Convention and will become a part of the Constitution of the State, providing for a State Board of Health to be composed of a president and eight members, five of whom shall be from the medical profession and three from such callings as the Legislature may designate; and,

WHEREAS, It is becoming more and more recognized that the Engineer is, by training and experience, particularly fitted to solve many of the problems, and to direct many of the activities of modern health work, particularly those phases which deal with community sanitation and control of insect-borne diseases, as is evidenced by the fact that the Legislature of a number of States are requiring the appointment of engineers as members of such boards, therefore

BE IT RESOLVED, by the Louisiana Engineering Society, That it heartily favors the appointment of an engineer, fitted by training and practice, to membership on the State Board of Health; and,

BE IT FURTHER RESOLVED, That the Society gives its unqualified endorsement to having a qualified engineer appointed as a member of the State Board of Health, and expressly requests the Legislature at its next meeting to provide for such appointment.

Upon motion, duly seconded, this resolution was carried and in accordance with the Constitution will be brought up at the next meeting.

A letter from the American Association of Engineers was read concerning the formation of an Engineering Club in New Orleans, and upon motion, duly seconded, the President was authorized to appoint a committee to investigate the matter.

The President exhibited a picture of the oldest tree in the world, which had been presented to the Society by Mr. James E. Zunts. Upon motion, duly seconded, the President was instructed to thank Mr. Zunts and to have the picture hung in the Library.

The meeting was then turned over to the Louisiana Section of American Military Engineers, Mr. A. M. Shaw, President; Mr. E. H. Coleman, Secretary. After considerable discussion by the military engineers, which was enjoyed by all, the meeting was adjourned to the usual collation.

JAMES M. ROBERT, Secretary.

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All business communications should be addressed to J. M. Robert, Secretary, P. O. Station 20, New Orleans, La.

PROCEEDINGS
OF THE
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CONTENTS

EDITORIAL NOTES AND COMMENT: PAGE

The Industrial Canal ... 185
The Delgado Trades School ... 187
A Note on Unemployment ... 189

OBITUARY ... 192

PAPERS AND DISCUSSIONS:

The Industrial Canal. *By Walter Parker* ... 193
Discussion ... 205

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY ... 209

EDITORIAL NOTES AND COMMENT

The Industrial Canal. This great project, probably the greatest engineering enterprise which has ever been carried out in New Orleans, is nearing completion. It has cost the tax-payers very much more than any of them ever anticipated, and much more than the maximum estimates of any of the engineers connected with its design and construction. If this had been known before hand probably the canal would not have been constructed. To date it has served as an excellent location for two large ship-yards, which now, however, are building no more ships.

The Canal is here and here to stay. The problem of the present and of the future is the use to which the people of this city and state are going to put it. Its opponents damn it as a horrible example of wasteful extravagance. Its proponents believe that the future industrial prosperity of New Orleans is so closely tied up with the Canal that to fail to develop its potentialities and its possibilities would be almost criminal on the part of the people of this city.

In his interesting address before the Society, a report if which is given elsewhere in this issue, Mr. Walter Parker, the father and ever-faithful defender of the great project, discusses the limitations of New Orleans in the matter of its future development as an industrial center, and points out how these limitations may be met, and in large measure overcome by the proper use of the facilities afforded by the Canal.

While New Orleans ranks as the second port of the United States, it must develop along industrial lines if it is to become one of the really great cities of the country. When industrial projects come to a seaport they desire as a rule to locate on the water-front; and this is the specific point at which New Orleans is greatly handicapped on account of the system of state control which prevails with reference to the river front. Although the owner of thee property along the river may be granted the privilege of erecting his plant, wharves, and other facilities, this privilege may be revoked in case the Dock Board finds it necessary to use this frontage in its own particular plan for the development of the port.

The keynote to Mr. Parker's idea is that this added facility of the Industrial Canal offers New Orleans an opportunity for development possessed by no other port in the world. To use his own words, "We must not only complete the demonstration of public ownership and operation on the river front, but complete a demonstration of public ownership of land and private leases and operation of facilities on the Canal, and private ownership of land and private operation of facilities on areas near and connected with the Canal by lateral channels."

Mr. Parker believes that industrial plants will locate in New Orleans if they can be assured the ownership of water fronts such as will be afforded by the Canal and its easily constructed laterals.

The natural outlet to the markets of the world for the products of the great Mississippi Valley is through the port of New Orleans; this should be an outlet not for raw materials but for finished products, and the finished products should be made right here at the point of shipment to the outside markets. This is really the true problem whose solution will involve the best and most efficient use of the facilities of the Canal.

The proper solution of this problem calls for the talents and wisdom of the best men of New Orleans in all lines of business, and for a spirit of solidarity and co-operation which has at times seemed lacking. It is a "get-together" proposition above all things else, and unless we do "get-together" on it some of us may live to see the day when the Industrial Canal lies idle and choked with water hyacinth, a burden to tax-payers and a dangerous liability instead of a most wonderful asset.

The utilization of any facility calls for a comprehensive plan of development, and from this point of view we are really just at the beginning of the problem.

The new Dock Board has a committee under the able Chairmanship of Mr. A. M. Lockett, whose duty it is to prepare such a plan. Knowing the character and temper of these gentlemen, we believe that they desire the assistance and co-operation of all interests and organizations in the city and the community to aid them with the proper development of the plan. It is a proposition, of course, in which all engineers should be interested, and the Louisiana Engineering Society has already evinced its desire to co-operate by offering its services in connection with the problems of the Industrial Canal.

Mr. Lockett has accepted this offer of assistance and co-operation by appointing Mr. Manley, President of the Society, a member of his Citizens' Advisory Board.

The Delgado Trades School. At the October meeting of the Society, Mr. H. G. Martin, Director of the Isaac Delgado Central Trades School, gave an informal address on the aim and objects of the school. Lantern slides were shown of the Rankin School in St. Louis to illustrate the equipment and methods of instruction used in a high-grade school of this type.

The Delgado Trades School is one of several benefactions of Mr. Isaac Delgado to the city of New Orleans, the other notable one being the Delgado Museum of Art located in City Park. In his will Mr. Delgado provided that his legacy was to be used solely for the building and equipment of the school funds for its proper operation to be provided by the city. Such provision has been made and the school is now open.

Mr. Martin traced the history of the development of the trade school idea and pointed out the very necessary distinction that should be kept in mind between the trade school as such and the so-called manual training school. The purpose of the former is to actually train the boy for a definite trade, his training in school serving to take the place of a portion of the long period of apprenticeship heretofore required in most of the skilled trades. At the same time the student is given a certain amount of training in fundamentals, such as English, Mathematics, Chemistry and Physics, these subjects being taught in such a way as to show their intimate connection with and bearing upon the particular trade being learned. It is the belief of the men engaged in this important field of work, and this belief is based upon actual experience with graduates of trade schools, that the trade school training will develop the better mechanic and a better citizen than the old apprentice system has been able to do. The trade school has won its way against considerable suspicion and opposition in the early stages of development, into the confidence of the best labor unions until it now enjoys their hearty co-operation and support.

The methods of teaching in the trade school requires a type of instructor who is not only a skilled mechanic in his own special line, but who has also had the training in the fundamental principles of teaching. Mr. Martin has been engaged for over a year in this line of work here in New Orleans and has trained in evening classes some very excellent teachers for the different trades. Teacher training work for the purpose of supplying teachers for industrial schools throughout the state will also be one of the functions of the Delgado School.

In the opinion of the writer the Delgado Trades School is the most important addition which has been made in recent years to the educational facilities of the City of New Orleans.

It will provide a system of apprenticeship coupled with a most excellent type of school training for the boy who has heretofore been denied the opportunity for further schooling beyond that of the grammar grades, on account of having to start in immediately at learning the trade under the conditions prevailing in the old apprentice system.

Vocational guidance is also an important feature of the trade school method, by which the boy is carefully observed at all stages of his progress, and thus enabled to train himself for the particular trade for which he is best adapted.

The success of this school means a great deal to the engineer, for the skilled mechanic and artisan is the right hand of the engineer upon whom he must depend for the successful carrying out of his designs. The training acquired in this type of school should produce a man excellently equipped to co-operate with the engineer.

A Note on Unemployment. If all branches of public works in the United States and the construction work of public utilities could systematically put aside financial reserves, in prosperity, to be used for improvements and expansion in depression, the recurring periods of business depression might be avoided, or at least greatly decreased, and the consequent unemployment of labor might be much less serious and widespread. This was the statement made recently by Edward Eyre Hunt, Secretary of the President's Conference on Unemployment, in his address before the Society of Industrial Engineers in New York City.

"A rough calculation indicates that if we maintained a reserve of only 10 per cent of our average annual construction for this purpose, we could almost iron out the fluctuations in employment," said Mr. Hunt.

The study of the business cycle, and its relation to unemployment, is one of the means by which the President's Conference hopes to provide measures for the permanent relief for the heads of families, who find themselves, periodically, thrown out of work.

"Unemployment on a vast scale is always a result of business depression," said Mr. Hunt. "The problem of preventing or mitigating unemployment is, therefore, part of the larger problem of preventing or mitigating alternations of business activity and stagnation.

"The world-wide scope and the long succession of business crises do not prove that the problem of controlling the business cycle is hopeless. . . . The business cycle is marked by peak periods of boom between valleys of depression and unemployment. The peak periods of boom are times of speculation, overexpansion, extravagance in living, relaxation in effort, wasteful expenditure in industry and commerce, with consequent destruction of capital. The valleys are marked by business stagnation, unemployment, and suffering. Both of these extremes are vicious, and the vices of the one beget the vices of the other. It is the wastes, the miscalculations, and the maladjustments grown rampant during booms that make inevitable the painful process of liquidation. The most hopeful way to check the losses and misery of depression is therefore to check the feverish extremes of 'prosperity.' The best time to act is at a fairly early stage in the growth of the boom.

"In any analysis of our productive processes, we can make a broad distinction between our additions to national plant and equipment, such as houses, railroads, manufactures, and tools on one hand, and the consumable goods which we produce on the other. At the present time we increase our activities in both of these directions at the same time and in their competition with each other we produce our booms. If all branches of our public words and the construction work of our public utilities—the railways, the telephones, etc.—could systematically put aside financial reserves to be provided in times of prosperity for the deliberate purpose of improvement and expansion in times of depressions, we could not only greatly decrease the depth of depressions, but we would at the same time diminish the height of booms. . . . Nor is this plan financially impracticable. Under it our plant and equipment would be built in times of lower costs than is now the case when the contractor competes with consumable goods in overbidding for both material and labor."

Mr. Hunt advocated the formation of adequate statistical service to determine three facts: volume of production of stocks and consumption of commodities; volume of construction in progress throughout the nation; the actual and not theoretical unemployment. This statistical service should be authorized and carried out by the Federal Government, he believes.

OBITUARY

Edgar L. Stream, resident member since 1915 of the Louisiana Engineering Society, died in New Orleans, October 23, 1921.

Mr. Stream was born in New Orleans sixty years ago and received his engineering training at the United States naval Academy at Annapolis. Some years after graduation from the Academy he resigned from the navy and began the practice of his profession, specializing in sugar engineering. He was adviser and consulting engineer for practically all the sugar refineries in this part of the country.

For many years he has been consulting engineer for the Vaccaro Brothers Steamship Company in connection with their operations and developments in Central America. He was also president of the Stream Investment Company.

Mr. Stream is survived by his widow, formerly Miss Emma Chase, of New Orleans, and three daughters, Mrs. T. M. Clapp, of Denver, Colo.; Miss Eloise Stream and Miss Eddie May Stream, and one sister, Mrs. C. E. McNeal.

PAPERS AND DISCUSSIONS

THE INDUSTRIAL CANAL

By Walter Parker.

Presented before the Society, September 12, 1921.

New Orleans Industrial Canal and Inner Harbor is a subject always new to me, but I have been talking about it so long that some of you may have heard before what I shall say to-night. That which I am going to tell you to-night is the same thing I have told the people of New Orleans for twenty years. I believe in it more to-day than I ever did before.

The Industrial Canal and Inner Harbor have been called simply a facility of the City of New Orleans—a new facility.

They are in fact the key to the greatest commercial and industrial goal that any port and any region, from the time the world began, has ever had.

There is no doubt, no question in my mind about this, and I do not think there is any doubt or any question about it in the minds of any men who have studied the problem completely in its economic relation to the trade region the facility is intended to serve.

In 1846 the merchants of New Orleans who were handling the flour of Cincinnati, floated down to New Orleans on barges, came to the Legislature that was then sitting in the old Hotel Royal, and asked for permission to build a shed on the river front, to prevent this flour from being ruined by the rain. They contended that the loss incurred by rain and mud in the handling of this commodity on the river front, in the absence of a shed, was so great that it was driving the commerce away. The Legislature replied that the river front had been segregated to public ownership, use and control, and none of it could be turned over to private enterprises, under any circumstances. These merchants went away very much disappointed, because they knew that the time had come when New Orleans must render a service far greater than any it ever rendered before, or stand the loss of the commerce. Because of the failure to build this shed, this commerce was lost. The flour left New Orleans, and never came here any more. Many other things of the same character occurred, all because private enterprise could not function on harbor front here as it does in other world ports. If its need is great enough to pay the price in other ports it can build its facilities and function. Here business enterprise has not had that opportunity. No matter how great its need was it could not function as in other ports.

In later years we got the Dock Board. The Dock Board took hold of a very bad situation, and has enormously improved it, but it did not overcome the fundamental handicap of the port, which was the absence of an opportunity for business to function here on water frontage as it does in other ports.

The Industrial Canal and Inner Harbor will solve that problem in a business way whenever we are ready, with a practical plan, to take advantage of that facility.

We have an opportunity for a complete system of public ownership and public operation. No other port in the world has such a great opportunity for a demonstration of public ownership and operation as the City of New Orleans has, because of retaining of the frontage, which in itself constitutes an enormous economic margin. The power of the Dock Board is practically as complete as it is possible to make it; consequently, we have an opportunity to carry out the principles of public ownership and public operation. We are making important progress in that direction. We have facilities now, whereas we have had none before. But that alone is not adequate for the port the Mississippi Valley requires here. We must do more. We must not only complete the demonstration of public ownership and operation on the river front, but complete a demonstration of public ownership of land and private leases and operation of facilities on the Canal, and private ownership of land and private operation of facilities on areas near and connected with the Canal by lateral channels.

There are three practical systems of port development—the three I have mentioned, and we stand alone in possessing full opportunities for the complete carrying out of all of those systems.

I know of many cases where we have lost large sums in commerce and wealth and progress and development because private enterprise could not function here as it desires to function. The United States Steel Corporation, through its President, Mr. Farrell, sought a location in New Orleans early in 1915. The idea was to build here a great terminal, where the output of the Birmingham factories, owned by the Steel Corporation, could be handled economically and stored at ship's side. He told me that the corporation intended to invest an additional twenty-five million dollars in their plants in Birmingham in a few years in order that they might turn out the products wanted by foreign trade, and that because New Orleans is a two-way port, and its ships come here loaded as a rule. General export cargoes can be had. Steel can only load a ship forty per cent. Thus New Orleans offers them a really economical shipping point on the Gulf. Mobile does not control the two-way cargo that we do. Therefore, his idea was to locate a great terminal here so that steel weighing all sorts of tons could be handled and stored as long as necessary until ships could pick it up. But he was told by the Dock Board that under our system he could not obtain a place on the city river front which he might rent, or buy, or lease, and that he could not build such a terminal as he had in mind, because of our policy of public ownership and operation.

I told him of the Constitutional Amendment providing for the Canal, and he said that would solve his problem. He even went so far as to offer—this man who is at the head of a corporation that has one billion dollars in capital—in order to get a site on which to put that building in New Orleans to assist in the financing of the Industrial Canal project. Nothing came of it. The negotiation started, and it fell through. It is a matter of no moment now why it fell through, but it did. The Steel Corporation has since purchased an island at Mobile, and is operating there in a large way as a one hundred per cent private enterprise, making a success of it, and is now a factor in the prosperity of Mobile.

Possibly if the export terminal had been built here we would also have secured the Steel Corporation's shipbuilding enterprise as well.

Not very long ago another enterprise almost as large as the Steel Corporation was in negotiation with us to put a plant in New Orleans—I will not mention the name in this case—but it is worth hundreds of millions of dollars. We started negotiating with this enterprise, and thought everything was in good shape. All of a sudden the negotiations came to an end, and it was weeks before we found out what the trouble was, and then we found out that a high representative of the Steel Corporation had called on the president of the corporation we were negotiating with and had said: "I am afraid if you go to New Orleans you will get tangled up with public ownership and not be able to carry out your plans. Come to Mobile and we will give you a piece of the island, where you will be free from this sort of thing." And we almost lost the enterprise. Later the arrangements for locating in New Orleans were completed.

This demonstrates clearly that we must have frontage that is free from public operation and public ownership. We can get that at the Canal. The Canal has been built; it is five and three-quarter miles in length. There has been an idea that the whole of that frontage, predicated upon the relation the frontage bears to the total cost, could be rented for a sum sufficient to pay the interest, and possibly a sinking fund to retire the bonds. I do not think that is possible at all. That was not the idea underlying the creation of the Canal.

The idea of building a canal was to make it possible, with a fixed level of water, controlled by locks, to run laterals through all that vacant land, which, I am told, amounts to nearly a hundred thousand acres that are now unused and of no commercial value at all to-day, and that this land, under a complete and comprehensive plan, should be given the opportunity to qualify itself as harbor frontage. That is, each acre that is to be made harbor frontage would contribute so much to the cost of the Canal, and the upkeep. That might amount to a thousand, or two or three or four thousand dollars an acre, whatever it ought to be. But, with a comprehensive plan (laying out the acres and the harbor as they should be, so that industries could be located properly in relation to warehouses and transportation, and those that follow them would be properly located), there would be basins, slips and harbors, and all that commerce and industry would require, all done as it ought to be done, and the whole plan could cover, not a period of a few years, but possibly a period of a hundred years, and utilize all, or as much of this great waste land as the valley commerce may need.

Each acre, as it is qualified as harbor frontage, would pay, either to the Dock Board or to whatever machinery might be used, a sum sufficient to qualify it as true harbor frontage. In addition to that, the acreage would have to pay for the digging of the lateral canals, basins, slips and harbors required to serve it. The land is worth, as harbor frontage, at least ten thousand dollars an acre. Some of it is worth hardly anything at all now. It has practically no commercial value at present. But with basins, slips and harbors for factories, and warehouses, all worked out as it should be, the land would be worth at least ten thousand dollars an acre.

There is a need for such facilities so great that there isn't a shadow or question of a doubt in the mind of any man who knows what is happening to commerce that in the course of relatively few years not one thousand, but ten thousand or twenty or more thousands of acres of that land will be actually in demand, and developed, and in use as harbor frontage and as a part of the Port of New Orleans.

This is where we get the three complete systems—public ownership and operation, public ownership and leases and private operation, and private ownership and operation free from every regulation and restriction that is not absolutely necessary to safeguard navigation and the carrying out of the complete plans.

Now, let's see what is happening to the commerce of the world that makes this Canal so essential to us, and to the Mississippi Valley.

There is not a single region in all the world that is to-day normal and ready to supply the wheat, corn and steel, and a thousand and one other things that civilization requires except the Mississippi Valley, that region between the Alleghenies and the Rockies, Canada and the Gulf which is penetrated by the navigable Mississippi and its tributaries, a network of thirteen thousand miles of natural waterways that will move commerce at a very low cost compared to anything we have ever known.

Asia is overpopulated and overgrown, Africa is undeveloped; Latin America, with its great natural resources, is underpopulated; Australia is largely undeveloped. There is no other region that can furnish, for a generation to come, the supplies the world will need. Economically, Europe is bankrupt. I was in Europe early in 1919. I was in conference with high officials of the Peace Conference. During half a day spent in such conferences I gained first-hand information as to Europe's economic position as a result of the war. And I want to tell you that not one single thing has happened since then to change my conclusions then formed that Europe is economically bankrupt, and that is all there is to it. Europe can never again function as the economic master of the world. European labor must have employment; it must earn a living in some way. Their currency is greatly reduced. If Germany can pay forty, fifty or a hundred marks a day wage, as against five or six or seven before the war, Germany is paying in the equivalent of our money less than a dollar of our money. Marks to-day are nine-tenths of one cent each. Recently German wages for skilled workmen were forty or fifty marks a day, as against five or six dollars here. Workmen there are in competition with our workmen at five or six dollars a day. We must offset that in efficiency and in economy of transportation.

We cannot afford to pay freight transportation charges to move freight over mountain ranges out of the drift of commerce as it is established now, and will be for many generations. We must follow the direct line, the easy grade railroad or the water course, to reduce our transportation cost to a minimum.

The markets of great promise in the future are not Europe at all. We do not want to sell raw material any more. We want to sell finished products. We want the profit of producing the raw material, and want the profit of the finished product, and selling it and financing it. We can only do that by completing the entire operation. If we go on moving raw products to the Atlantic Seaboard and there have it translated into a finished product, we have to send the food that the workmen there eat, and we will have to pay freight on that, and we will have to send building material to build the houses they live in, and have to supplement their labor supplies with ours. Then when the stuff is finished it is further away from the markets we desire to supply than it would be if it had been manufactured in the valley and then moved out this way, which is the easy way.

Latin America offers us our great opportunity in building new markets. They have great plateaus of soil, capacity for hundreds of millions of people—surplus people from Europe forced to migrate because of the tax burdens and the difficulties of making a living.

Latin America has mountains, forests and water courses. I believe that the rough figures show that the digging of canals totaling fifty or one hundred miles in length, connecting the headwaters of the Oronoco, the Amazon and the Platte Rivers, will give South America a complete network of waterways connecting the Caribbean Sea with Buenos Aires. The cost of such canals would be very small in contrast to the enormous good that would come from them.

In developing Latin America, which is the next great region awaiting attention, we will have something worth while to exploit. Business cannot be carried on on a service charge alone. It must have collateral profits, otherwise it cannot get very far. Latin America offers us the next great field. This time we will take our raw material from Latin America, translate it and sell it back to them. That is what Europe has been doing for us during the last hundred and fifty years. We will have factories and the machinery, and do just as Europe has been doing in the past. Then we will occupy a more favorable economic position.

New Orleans is in the line of the low cost trade route between the valley and these new markets, but we must have facilities for handling that commerce. No man on earth who has a comprehensive thought of what this means will think that the shoestring area that we call our harbor front, one or two hundred feet wide, not wide enough at all, will serve this commerce. We need a wide region for development, not a mere shoestring strip along the river front. We must plan for a complete whole.

Before there was steam power for the mills, through years and years of effort hand labor had succeeded in raising its wage, in relation to the value it produced with its hands, to a point where there was practically no economic margin left to the employer. Hand labor had spent several thousand years on that job. Then machinery came along, and, instantly, or practically so, the product of each individual labor unit multiplied many fold. The product of each individual workman was always multiplying because of better machinery. But if he were paid five or six times what he had been paid, and his labor output, by reason of machinery, was ten or twenty times what he had been putting out by hand, you can see the enormous increase in relative profit or economic margin that came to the employer. It was through this economic margin that industry in Western Europe and the United States was enabled to make such wonderful progress in the last hundred years.

Up to the time the war broke out labor, realizing more and more that there was a full economic margin of profit to the employer between the cost and selling price of the products of machinery operated plants, demanded more and more concessions. Then the war came along, and broke down the employer's defenses against labor's demands. The Government radically advanced labor's wage, destroyed the balance of things overnight, and spoiled the whole machinery of the relations of labor and capital. After the war we found this: That in productive time given work by the skilled employee, and in the wage collected, labor to-day collects so close to the sales value of the product yielded through its efforts that the economic margin of industry has been largely wiped out. There is still a profit for the manufacturer, or he would not operate. But, without a profit, plus an economic margin, industrial investment in capital and enterprise cannot be safe; clearly it has reached a somewhat unsafe condition.

In order to put this whole Mississippi Valley in such shape that it can progress and feed, and clothe the world, as called upon to do during a long period of reconstruction, we must find an economic margin for the industries of the valley. We can work it out in agriculture by draining marsh lands and giving the farmers soil that will produce more per unit of labor employed than the land they are now using. If agriculture holds up its prices somebody has to pay them. High prices do not necessarily create an economic margin.

If we can develop lower cost transportation, and build more efficient terminals, that will reduce the cost per ton of delivering this stuff after it is produced, we will have created a new economic margin, because the cost for labor, machinery and transportation combined is now largely predicated upon present-day transportation costs. If we can pull down that transportation cost fifteen, twenty, thirty or forty per cent through increased efficiency and the use of new channels, it will take years for labor, or anybody else that is getting a rake-off out of industry to understand that, just like it took years to understand the fine points of machinery operation and take advantage of it. In the meantime there will be a new economic margin, which is the most valuable thing commerce and industry know.

The railroad was preceded by boat lines on the Mississippi River. Look at any old steamboat, and you will see an enormous saloon, big kitchen, plenty place for the crews, and a little narrow strip on the lower deck for the freight. Those boat lines started out handicapped. They had no terminals. There is not yet in the entire Mississippi Valley a single truly economic boat terminal.

The Mississippi River barge line moves freight at twenty per cent less than the rail rate. That is so important a saving at a time when commerce is trying to save every cent it can that this barge line has more commerce than it can handle. It is striving to build new power units, to build and move more barges to take care of the surplus. It is doing that before proper terminals have been built. When the terminals shall have been built, and all things worked out as they should be, as good business men would work them out, the differential will be forty or fifty per cent below the rail rate. This barge line creates not only a new and low cost transportation facility, but a new economic equation in transportation. Completion of channel work will put Minneapolis, Pittsburg, Kansas City and Chicago in the closest possible transportation touch with every section of the valley. It will actually control the drift of commerce. Old line transportation men have not yet figured it out, but it will work out just as sure as the sun shines. Then the Southern, the Illinois Central and other great valley railroads will be free from domination by the East and West roads. The North and South rate will not then have to be predicated on New York or Baltimore differentials, but we will make the structure to meet the condition based upon the cost per ton mile of running trains over flat railroads instead of mountain grades, and we will get a new transportation structure. This is the process through which a new and valuable economic margin may come to the great valley.

New Orleans' foreign trade has grown enormously in recent years. So many more ships now come to New Orleans, in spite of the fact that the four great commodities, lumber, cotton, sugar and rice which normally New Orleans would depend on for its livelihood, have been depressed, New Orleans has not suffered in business depression as much as other cities in the country.

In fact, New Orleans has pulled through, to the best of my knowledge and belief, better than any other section of the country.

The drift of commerce, impelled by this low freight rate, has returned to the North and the South channels of trade. This has pulled us across in a time of great business depression.

This great valley, between Canada and the Gulf, is the only region in the world that now has the capacity for low cost transportation, and possesses the soil, climate, skilled labor, factories, raw material and food supply to enable it to function as the base of supplies for the remainder of the world, and our commerce will be multiplied, not twice, but five times, ten times or more, since the world must draw upon the valley during a generation and more to come, as it is the chief reliance. Other sections of the world may help, but this must be the backbone, and this capacity for cheap transportation will turn the commerce this way.

The markets of great promise—Latin America, which will need rails and tools and manufactures—must look to us. We will have to supply them with the things that are finished, and take from them their rice, wool, mahogany and products of their fields in exchange. The Orient and Africa in the same way must look to us.

When you think of it all in its large aspect, what are one hundred thousaid acres of potential harbor frontage! When you realize that every one of those acres, as they are needed, can give to the Dock Board two or three or four or five thousand dollars as a payment for the privilege of making itself a ship harbor frontage in tieing itself to the Canal. Can any man fear that the cost of the Canal will not be paid for by itself? There is no argument about it to me. I cannot figure it any other way. I believe in the end the returns that will come from that Canal as it is developed and used will pay off the cost of the Canal and the cost of the bonds issued on the river front, and we can then have a free port.

How are we to get at that? No really comprehensive thought has yet been given to how we are to use that Canal, and what it was for, by the public body in control. Most people knew it was being built, that it cost a good many million dollars, but few gave any thought whatever to what we were going to do with it after it was finished. The Dock Board does not yet know. We have got to get down to business, and the people who are able to think in terms of economy—port, transportation, commercial, financial, industrial economy—have got to think about this thing in a big way, and we must see to it that a plan that will cover a period of years and years and years is devised, and that we live up to that plan, and that that plan will give the three systems of port development absolutely free play:

Public ownership and operation on the harbor front.

Public ownership of land and private operation of facilities on the Canal.

Private ownership of land and private operation of facilities on nearby lands to be made harbor frontage.

The moment we form a party demanding such a Canal plan, and we have influential men who believe in the value of such a plan, we will get the plan. It is simple to work out. A man must know the relation one thing bears to another in port economy, and must also be able to point to what the remainder of the world has done. We can work out a plan that will be practical. The Dock Board can put it into effect and go ahead and exploit it. The moment that plan is ready another thing must be made to happen.

The reason Colonel Dent, army engineer in charge here, did not openly report in favor of a channel to connect the Industrial Canal with the Gulf of Mexico, was because there was no plan for the use of the Canal and such a channel. The moment there is a plan the Government engineers will become interested in working out a channel to the Gulf, because that channel offers many advantages in addition to that of an insurance policy of valley safety; it will guarantee to the Mississippi Valley that there shall be no interference from any cause with its ship channel to the sea. We are not now sure that we will always have a channel to the sea as deep and as wide and as safe as we desire it to be.

This artificial channel could be made forty feet deep almost as easily as thirty. I am told there is no question about that. The cost of maintaining it should not exceed half a million a year, and the cost of building it should not exceed ten or twelve millions. What is that to the commerce of a port that is aspiring to handle, not one billion dollars a year, but ten or more billions of dollars a year in foreign trade?

There is not anything that stands as a barrier to the attainment of the larger goal except our own hesitancy and unwillingness to open our eyes. Whenever we start out to use that Canal and develop a plan that will carry us to success, we can get the new channel to the Gulf.

I think that just about covers the story I have been telling during about twenty years. It always makes me feel better to tell it again, because I always hope somebody is listening who will get something worth while out of it.

DISCUSSION

Mr. Chairman: You have heard this interesting paper of Mr. Parker. I should like very much to have it discussed by gentlemen who have had a chance to study the problem. Mr. J. F. Coleman is out of town. The chief engineer of the Dock Board is unable to be here. I believe Major Shaw is absent also.

Mr. E. H. Coleman: Mr. President and Members of the Society: I have no discussion to offer in regard to Mr. Parker's paper. The problem of the development of the Industrial Canal is one on which my firm has done considerable work and I would rather not discuss it at present. One statement Mr. Parker made I would like to correct, and that is in regard to one of the Steel Corporation plants in the South. He mentioned the plant at Mobile and spoke as though that plant would have been located at New Orleans had there been a place to put it. There was never any intention of putting that plant at New Orleans, and New Orleans could not have been considered even if there had been a location such as the Industrial Canal.

Mr. Parker: Mr. Chairman, in answer to that, I am quite ready to admit that the plant at Mobile was never intended to be put at New Orleans, but Mr. Farrell told me if there were a place—a harbor front site—for him to put a handling plant on here he would put it here. Probably at the time he told me that the plans for a shipyard at Mobile had not been conceived. He had reference to the building of a great terminal to handle the output of the Birmingham mills. I had reference only to a terminal. Had that terminal been built in New Orleans, and then had there been a favorable site available for a shipyard, we might have secured the Chickasaw plant.

Mr. E. H. Coleman: Mr. President. I understood Mr. Parker to say that the Mobile plant would have come to New Orleans if there had been a place to put it. I didn't understand him to name the Chickasaw plant, but the Chickasaw plant is the only steel corporation project at Mobile. There was never any intention of locating this plant at New Orleans, and I understood Mr. Parker to say that it would have come here had there been a suitable site.

Mr. Parker: My conversation was about a handling plant; if there had been a place to put the Chickasaw plant possibly it may have come here; I don't know about that.

Mr. E. H. Coleman: It would not have.

Mr. Malochee: I have one question to ask. I have been told on a number of occasions that the channel of the Canal is not a stable one, and in many instances the bottom is coming up, and that it will be impossible that they can maintain that channel except at a considerable pumping expense. I know nothing personally about that, except it has been stated to me on many occasions, and I would like to know if anybody here knows anything about that.

Mr. Parker: I do not know.

Mr. Williams: I can only answer it insofar as our plant is concerned. There has been no change in the depth of the water there. I think we have about twenty feet there.

Mr. Coleman: I think the bottom of the Canal will come up slightly in some places, but I think any channels anywhere require a certain amount of maintenance. I don't think there should be any unreasonable difficulty in maintaining the depth of the channel.

Mr. Williamson: Mr. Chairman, I don't think we ought to let a discussion that has been so ably presented pass without a comment further as to really what it means. We have talked a good deal in Louisiana, and in the South, about our resources, and about our great wealth. Unless we unlock our wealth we haven't any. It is dead, and I might compare our Canal down here, not as largely, but in a way to the electrical power installation at Niagara Falls. When the first unit was put in there was no plan in their minds to even develop a process for a single industry using power for electro-chemical processes that govern the markets of the United States. There wasn't a single resource. The production of aluminum that is used so extensively wasn't perfected. We haven't a single industry located on the Canal, but that is no reason why we shouldn't have the Canal, and I think we should compliment Mr. Parker on the able talk he has given, and for the able work he has done with reference to starting something. The bed of the thing may buckle, but I think if it buckles we must unbuckle it. I think this means more to us than a discussion of whether bed buckling will take place or not, because I think it is the unlocking. Our salt at Avery Island is only worth four dollars a ton, but split up it is worth one hundred and twenty dollars a ton. Our pretroleum is being burned up and consumed in ways that should never be permitted. Our natural gas will go the same way, if we continue to let it loose. I think this canal project is a great step in the right direction, even if we are to get one that might buckle at the bottom. I want to offer a motion of thanks to Mr. Parker for his talk to-night.

Mr. Malochee: I second that motion.

The Chairman: Before putting the motion of thanks to Mr. Parker, I would like to call on Mr. Bernhard, as I understand he has made a study of this project.

Mr. Bernhard: As an engineer, this Canal is close to my heart. I desire to point out the great importance of a definite plan for the utilization of the Canal. There is nobody more to blame than the engineers of Louisiana for the lack of such plan. It is time that we, as a body of engineers, should become aware of the great need of investigating the possibilities of the Canal from an engineer's standpoint and form for its future the way in which it should be developed. It would be easy to destroy the value of the Canal if we let each industry locate itself on the banks of the Canal as it sees fit merely because it would be a user of the Canal. A few shipyards and the like improperly located would make it impossible to get the bigger business essential to the Canal's success which must make New Orleans the largest port of the world, provided we foster true economy in developing our Canal. I am led to believe the only way to use the Canal is by going after certain key industries. These will force the coming of other ones, which always follow in the wake of the key industries. If you give the impression that industries may locate at will, then it may happen that later on industry that gladly would have sought the location between two allied industries sees such attraction of finding a source for raw materials and a market for its by-products next door to it destroyed. We engineers must be held largely responsible if New Orleans fails to safeguard this great potential economy. Another point I want to bring home is this: You plan in educating your child for forty, sixty or more years in the future, should you be more shortsighted for the future of your city? You must make a plan for the Industrial Canal that covers generations. Is there any reason why we should not adopt a plan looking centuries ahead?

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Board of Direction, September 12, 1921.

The regular meeting of the Board of Direction was called to order with Vice-President Derickson in the chair and Messrs. Moses, Lawes, Barelli, Riess, Nelson and Robert present.

Upon motion duly seconded, the applications of Messrs. R. B. Kohnke and J. A. Lorio were referred to the Membership Committee.

A communication from the Engineers' Club of Philadelphia concerning the joint publication of a journal with other societies was read and the invitation declined.

Upon motion duly seconded, the resignation of Mr. J. M. Gwinn, Jr., was accepted.

The report of the Secretary was read and approved and bills ordered paid.

A communication from Mr. Frank R. Shaw was read and the Secretary was directed to write to the Federated Enginering Societies and to our representatives in Congress to lend their influence to the passage of H. R. 7541 concerning the commissioning of Sanitary Engineers in the Public Health Service.

There being no further business, the meeting adjourned.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Society, September 12, 1921.

The meeting was called to order with Vice-President Derickson in the chair and forty-one members and guests present.

There being no business to come before the meeting, the technical exercises were proceeded with and consisted of an interesting address by Mr. Walter Parker, Secretary of the Association of Commerce, entitled "The Economic Value of the Industrial Canal." After some little discussion Mr. Parker was tendered a rising vote of thanks.

The motion of Mr. Lawes concerning Engineers on the State Board of Health came up for second reading, and upon motion duly seconded was passed. Upon motion duly seconded, it was the sense of this meeting that a committee of one be appointed to work with the Board of Engineering Examiners to go to Baton Rouge and have inserted in the Highway Department Bill that none but registered engineers be employed by that Department. The motion was carried unanimously. There being no further business to come before the meeting, the same was adjourned to the usual collation.

JAMES M. ROBERT, Secretary.

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LOUISIANA ENGINEERING SOCIETY

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PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

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CONTENTS

EDITORIAL NOTES AND COMMENT: PAGE

Natural Gas for New Orleans 211

The Membership Campaign 213

Several Kinds of Engineers 214

Restoring Devastated France 215

New Members 216

Dye and Coal Tar Industries in the United States 217

PAPERS AND DISCUSSIONS:

Natural Gas for New Orleans. *By A. M. Lockett* 218

Discussion 231

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY 242

EDITORIAL NOTES AND COMMENT

Natural Gas for New Orleans. Why is it that a city of the size of New Orleans, within comparatively easy reach of enormous fields of natural gas, has not yet brought in the gas for industrial and household purposes? Ask the man on the street, and you will get a variety of answers, some of the most emphatic and dogmatic issuing out of the abundance of ignorance of the answerer.

The average citizen has been taught to believe, unfortunately by ill-informed teachers in many instances, that natural gas is a commodity which should be sold to the consumer at a price so far below the price of manufactured gas as to make the continued use of the latter seem like a frightfully wasteful extravagance. This attitude of mind is to some extent justified by many examples of wasteful practices on the part of the producers and consumers of natural gas in the past. These extravagant practices are at the present day, however, being checked and stopped, for the result has been in many cases a very serious depletion of the sources of supply.

There are two natural gas fields upon which New Orleans could draw, Houma, within a distance of fifty miles; Monroe, two hundred and fifty miles away. The former is new, and it is alleged in many quarters, unproven. The latter, according to the conservative estimates of the best gas experts of the country, is proven both as to quality and quantity, and provided the field is properly handled should give a recovery of 150,000,000 cubic feet per day for forty-three years. In addition to these two available fields, there are many people who believe, or profess to believe, that the territory in and around New Orleans itself is underlaid with great supplies of natural gas. Why not wait until we can drill wells and get it right here in our back yards, so to speak? This is their great slogan, and the attitude has been one of the principal causes of the failure to date to bringing natural gas to this city.

In his paper, published in this issue of the Proceedings, Mr. Lockett takes the ground that New Orleans should bring its supply of natural gas from the Monroe field. His paper does not touch upon the technical side of the matter, but has to do with the economic or business side. Mr. Lockett states very frankly that the object of his paper is to enlist the support of the engineers in a campaign of education of the people of New Orleans as to the real facts of the natural gas situation.

Every time the matter comes up for active discussion, all these old arguments are brought forward, and New Orleans still has no natural gas. As engineers, we should use every effort to educate the people to an understanding of the economic situation, and to an appreciation of the fact that New Orleans is never going to be able to secure natural gas at the ridiculously low prices which have prevailed in some other localities.

One of the most important factors of the problem is the distribution after the gas has been piped to the city. It is out of the question to expect to tear up the streets and parallel the existing system of the New Orleans Gas Light Company with an exactly similar one. This means that the existing system of distribution must be used and that the cost of distribution cannot be greatly reduced below its present figure. Add to the cost of distribution the cost of the gas itself and an amount to take care of the amortization of the cost of the pipe line, and it is not likely that the cost to the consumer at the beginning of operations will fall much below ninety cents. This figure, of course, will be reduced as the consumption increases.

A significant point brought out in the discussion was that as long as New Orleans continues to burn manufactured gas at $1.45, when it can secure natural gas at about $1.00, the people are losing about $1,500,000.00 each year. In six years this saving would pay the estimated cost of the pipe line from the Monroe field.

In summing up the discussion Mr. Lockett says: "I am in a position to say that there are men figuring on the Monroe pipe line. If they decide that it is an economic proposition, it will be brought here, unless the people have an unfriendly attitude towards it, in which event it will be dropped quickly. I think this Society could do quite a lot in bringing about the feeling that will be required to carry out the proposition."

The Membership Campaign. It goes without saying, almost, that every qualified engineer in this community should be a member of the Louisiana Engineering Society. Many such men are not members, for various reasons, the most usual are, however, being that they have simply neglected to take the necessary steps to become members.

A membership drive has been organized, and to add a stimulus to the work of the committee Mr. Ole K. Olsen has, with his chararteristic generosity, donated the sum of $150.00 to be given as a prize for increasing the membership. The details of the award have not yet been decided upon, but if you wish to make some extra change, it would be well to get busy and try to secure as many new members as possible. We are informed that there is already quite a large number of new applications before the Board of Direction for approval.

Several Kinds of Engineers. In the November issue of *The Michigan Technic* Mr. J .T. N. Hoyt discusses several kinds of engineers and expresses his opinion as to what the "real engineer" is. Quoting from the first part of the article, he says:

> "The training of the undergraduate engineer consists almost wholly of the mathematical component of engineering, and therefore he is likely to believe that engineering is an exact science, and that he knows it. In fact, if he becomes a member of that large group of engineers, the theoreticians, engineering will always be to him an exact science, and nothing more. This group of wing-footed messengers of the gods never come any nearer to earth than the top of a mountain range in their flight through space, spinning on their way their invisible threads, and having their mortal and immortal combats far above the vision of man.
>
> "There is another group which consists of those who have abandoned their original belief that engineering is an exact science or any kind of a science, and hold that it is a vast and never-ending series of laboratory experiments. Their entire career is spent behind closed doors and drawn curtains, where they labor under red, green and blue lights, and wave their magician's wands through unlimited undulations. From such retreats they send forth table after table of experiments and diagram after diagram of curved lines, which are soon followed by other tables and diagrams of entirely conflicting character.
>
> "The gyrations of these two groups do not, however, constitute engineering, which is the 'Art of turning the great sources of power in nature to the use and convenience of man.' To the real engineer, these two groups are merely two of the sources of power in nature.
>
> "The real engineer, having acquired a knowledge of the mathematics of engineering, must also acquire a liberal knowledge of the sciences and arts, on account of their relation to engineering; also of the basic principles

of law, in order to determine facts and the reliability of evidence also of the principles of practical gambling.

"For in spite of his continually increasing store of knowledge and his most searching analysis of a problem, there are always unknown conditions, and if the engineer will not take a gambler's reasonable chance, he will find that the curtain has been drawn down on him and his problem, and the world, impatient of waiting for his answer, has gone on without him."

Restoring Devastated France. In the December issue of *The Valve World* are given some interesting figures as to the way the people of France have undertaken the problem of restoring industrial and housing conditions in those parts of the country so frightfully devastated by the Germans:

"To turn from our own industrial troubles for a moment and take note of what is being done in France is refreshing. Careful computation shows that at the signing of the armistice there were 289,147 farm buildings and houses destroyed; 164,317 badly damaged; and 258,419 slightly damaged.

"Of these, to September 1, of this year, 29,364 had been entirely rebuilt; 182,189 had been provisionally repaired; and 116,760 definitely repaired. Out of 4,754 plants, factories and mines destroyed, 3,769 have been wholly rebuilt and 614 are in course of construction. Destroyed railroads and canals have been practically one hundred per cent restored.

"It will be noted that the mines and factories, which served the whole people, have been dealt with first, that farms have come next, and that rebuilding of the towns has been left to the last. Curiously France has been helped by the very magnitude of her task. Much of her amazing progress has been due to the fact that there has been a definite work to be done. Thrift no less than industry has brought about the result. A staggering handicap thus almost has been converted into a blessing, in both the material and the spiritual sense."

New Members. Since the publication of the last issue of the Proceedings Mr. Alfred A. Lanaux has been elected a resident member of the Society, Mr. Jules A. Lorio a non-resident member, and Mr. Richard B. Kohnke has been transferred from Junior to Resident Member.

Statements of their professional records are given below:

ALFRED A. LANAUX, 307 Vincent Building, New Orleans. Age 50 years. Endorsed by John H. Murphy, E. F. Delery, Sidney F. Lewis, Frank M. Kerr, Walter H. Hoffman.

Superintendent of Industrial Plants, 15 years; designing machinery and complete equipment and installation of industrial plants, 15 years, as follows: Designed and supervised installation of canning plant, Penick and Ford, New Orleans, 1909-1910; designed all apparatus and plant, costing $1,250,000, for Yaryan Rosin and Transportation Co., Brunswick, Ga., 1911-1912; designed and built small wood distilling plant, as above, for Pineland Naval Stores Co., Lake Charles, La., 1913; this plant he managed for one year; designed and managed wood extraction plant utilizing mill waste, for Producers' Turpentine Co., subsidiary of Industrial Lumber Co., Elizabeth, La., 1914-1915; superintendent of Industrial Alcohol Co., Fullerton, La., 1915-1916; this plant makes ethyl alcohol from sawdust; testing of case-head gas of every well of the Standard Oil Co. in Louisiana, and building of the first recovery plant at Trees, La., in 1916; draftsman and designer for National Blow Pipe and Manufacturing Co., New Orleans, 1917; engineering work for the U. S. Quartermaster, New Orleans and Fort St. Philip, 1917-1918; in 1918, designed and built plant and complete apparatus for recovery of waste products and refining of naval stores for the Gulf Naval Stores Supply Co.; has served the Naval Stores Supply Company as consulting and supervising engineer until April, 1921, when he entered general practice, though he is still connected with this firm in an advisory capacity.

RICHARD BURTON KOHNKE, 119 South Anthony street, New Orleans. Age 33 years. Endorsed by John Riess, Wade Barnett, W. B. Gregory.

Graduated from Tulane University as Civil Engineer, 1912; draftsman, inspector and assistant engineer for the Sewerage and

Water Board about 4 years; superintendent of construction for John Riess, 15 months; engineer Island Refining Corporation, Sallers, La., 20 months; at present with Import and Export Petroleum Corporation, St. Rose, La.

JULES A. LORIO, Belle Helene, La. Age 29 years. Endorsed by Walter B. Moses, D. B. H. Chaffe, Jr., Leo S. Weil.

Chief Engineer, Belle Helene Sugar Co., one 900-ton sugar mill and factory; has designed the necessary gear for an additional drive; installed an additional mill; re-designed and installed a crusher; installed a modern cane car unloader on own design and installed modern electric pumping plant.

Dye and Coal Tar Industries in the United States. Professor C. S. Williamson, Jr., of Tulane University, has been addressing the various scientific and commercial bodies of New Orleans and other sections of the state on the subject of the proper protection of the dye and coal tar industries of this country. As a result of his presentation of the subject before this Society, the following resolution has been passed and endorsed:

> WHEREAS: The dye and coal tar industries are the key industries to the manufacture of explosives, medicinals, and gases for warfare, and
>
> WHEREAS: The dye and coal tar industries were undeveloped in 1917 to our embarrassment, for explosives, gases, and medicinals, and are yet in their infancy in this country, and
>
> WHEREAS: Our national security is vested in maintaining and developing our dye and coal tar industries, and
>
> WHEREAS: A protective tariff in the past has not afforded sufficient protection to allow the establishment of these industries,
>
> BE IT RESOLVED: That the Louisiana Engineering Society endorses selective embargo or selective licensing as protection of these industries that their development may proceed to a point of security.

PAPERS AND DISCUSSIONS

NATURAL GAS FOR NEW ORLEANS

By A. M. Lockett.

Read before the Society, November 14, 1921.

When I was invited by the Chairman of your Committee on Technical Papers to prepare and read a paper on Natural Gas for New Orleans, I realized that I was not properly equipped to write such a paper as is usually expected when such an invitation as this is extended, but it occurred to me that by reason of a connection which I had with an effort on the part of some of the commercial bodies of New Orleans made some two years ago to secure natural gas, I might be able to perform a useful service by presenting to you some practical conclusions which I formed at the time of the effort just referred to.

In my opinion there are two basic elements of the situation which are necessary for bringing natural gas to New Orleans. One is, the attitude of the public must be friendly in order that franchises and privileges may be secured, and the other is, the economic conditions must be such as to justify the expenditure of the money involved in the proposition. So far as the economic conditions are concerned, they are what they are and they cannot be changed by any effort which any one of us or all of us together can make. The only thing that we, either as an engineering organization or a body of citizens, can do is to sow such seed in the minds of the public as will result in public opinion being friendly rather than unfriendly to the proposition. There is a conviction in the minds of the people that natural gas can and should be sold at an exceedingly low price. This conviction is not without foundation, because not only is the gas a natural product which appears to be in unlimited quantities, but there are many instances on record where the prices which the people claim should be charged have in fact been charged and are still being charged by natural gas companies.

I believe a very constructive step can be taken if this Society would interest itself in educating the people to a proper understanding of the value of natural gas, because whatever may have been done in the past in respect to prices for natural gas, I feel safe in saying that those gas companies who will hereafter engage in this business will not make the fatal error which was made by practically all of their predecessors. I do not believe that New Orleans will ever get natural gas unless its citizens become reconciled to the payment of a price reasonably near its actual value, because, except under such circumstances, no capitalist will undertake the work.

It was for the purpose of inaugurating such a movement in this Society that I not only consented to prepare and read this paper, but I was very glad to have this opportunity to perform a service which may possibly result in real benefit to the community.

I am sold on Monroe gas for New Orleans, and if I succeed in selling the idea to you I shall be extremely gratified. I am not interested financially in any gas field, gas pipe line, or distributing company, but I am vitally interested financially in the industrial development of New Orleans. The reason why I am trying to sell you the idea of Monroe gas is because it is not open to any question as to quality or quantity, whereas all the other gas fields nearer to us than Monroe, whether actually proven or existing only in the minds of optimistic promoters, are not able to qualify in the prime requisite of dependability. I wish to say right at this point that there can be nothing more fatal to such a campaign of education as I am proposing than for us to give undue consideration to the reports of prospects of natural gas in the immediate vicinity, because such reports create a fear in the minds of the people that if they should enter into an agreement for gas at prices which they will have to pay to get Monroe gas, they might find in a short time that they could have done better had they waited. These reports have been current in New Orleans for many years and the complexion of them now is practically the same as at the first report of this kind made. These reports undoubtedly had much to do with our failure to get the gas from Houma when it was offered. The answer to all such reports is that we shall be only too glad if gas is found in the immediate vicinity of New Orleans, but whether or not it be found it should not affect our intention to connect up the great gas fields at Monroe with New Orleans, nor will there be any economic loss by so doing, because wherever the gas may me found, if it is available to New Orleans, it will eventually be needed.

There has been published by the Louisiana Conservation Department a most interesting bulletin, known as Bulletin No. 9, which is a report made by Messrs. H. W. Bell and R. A. Cattell, petroleum engineers of the U. S. Bureau of Mines, and I urge that every member of this Society who has not already secured a copy of this book do so without delay. In order to arouse your interest in this matter I wish to recite some of the salient facts brought out in this report:

> "The Monroe gas field is one of the greatest assets of the State of Louisiana. It probably has the greatest potential capacity of any discovered gas field. Its 65 gas wells have an open-flow capacity of about 620,000,000 cubic feet per day. The proven productive area is about 212 square miles. The productive horizon has an average thickness of not less than 50 feet, and the initial rock pressure of about 1050 pounds per square inch has shown no appreciable decline since the 'Discovery Well' was struck into the gas rock in 1916."

Based upon data obtained from the records of the existing wells, these two engineers estimate that if totally recoverable this field would supply gas at the rate of 100,000,000 cubic feet per day for 130 years, at a pressure of eight ounces per square inch. They say that if existing wells are put into the best possible shape and properly cared for in the future, if no more wells are allowed to go wild, if all future wells are properly drilled and properly cared for, and no more wells are drilled than are needed, at least 50 per cent of the gas should be recoverable. The field then should give a recovery of 150,000,000 cubic feet per day for forty-three years. Of this 100,000,000 cubic feet should be delivered to the consumer. These engineers say, further, that they regard the figures just given as conservative and that it is possible that the amount of gas in the reservoir is much more than has been estimated. As to the quality of the gas, the bulletin gives the following: "The quality of the gas is not uniform throughout the field. The gasoline content is greatest in the southeast portion of the field and decreases toward the northwest. Some of the wells showed as high as 434 gallons of gasoline per million cubic feet and some showed no gasoline. The heat units in the gas range from 903 B. t. u. to 1096 B. t. u." As proof of the enormous quantity of gas in this reservoir it is stated that although it is estimated that ninety billion cubic feet have been removed there is practically no decrease in the rock pressure. With such a picture as is presented by these government engineers, I am sure no argument is needed to convince you that New Orleans should have a pipe line from the Monroe gas field.

Natural gas is a fuel, and like all other fuels its value depends upon the amount of heat it will give off when burning. In the particular case of gas fuel, either natural or manufactured, it is capable of being used in ways in which no other fuel in its natural state can be used, and therefore one may truthfully say that natural gas has two values, one of which is arrived at by a comparison with fuels such as coal and petroleum when these fuels can be used in their natural state; the other value is one arrived at when you compare natural gas with manufactured gas in uses in which manufactured gas is current. It is the case that one kind of fuel may be burned under a particular set of conditions with greater efficiency for the heat consuming apparatus than some other kind, and therefore not in all cases are the true relative values represented by the number of heat units obtainable by analysis, but for the purposes of this paper I shall arrive at my values by taking into consideration only the heat units available.

Bulletin No. 9 gives the heat values of the gas from various portions of the field as ranging from 903 to 1096 B. t. u., or an average, in round numbers, of 1,000. With 1,000 B. t. u. per cubic foot, one pound of coal having 14,000 B. t. u. is equal to fourteen cubic feet of gas, and 1,000 cubic feet of gas (the usual selling unit) is equivalent to 71.4 pounds of coal. With coal at $5.00 per ton, or one-quarter of a cent a pound, natural gas would have to sell at about eighteen cents per 1,000. With coal at \$4.00, the gas price would have to be 14.4 cents per 1,000. In comparison with oil having 18,000 B. t. u. and taking the weight of a barrel at 326 pounds, gas at eighteen cents per 1,000 cubic feet would be on a parity with oil at \$1.08 per barrel. Such a comparison as the foregoing would apply to the use of gas under steam boilers and in general may be referred to as industrial use.

In arriving at the value of natural gas for domestic use, or as a substitute for manufactured gas, and considering only the relative heat values, we must consider the following figures. What may be called the standard for manufactured gas is 600 B. t. u., so, whatever is the price of it, the value of an equal volume of natural gas will be in the ratio of ten to 6, which means that if manufactured gas is worth \$1.45 per 1,000, natural gas is worth \$2.40 per 1,000. Taking the lowest heat value of any gas in the Monroe field at 900 B. t. u. this gas would have a value of \$2.17.

Please keep in mind the fact that we are now considering values and not prices—values arrived at by comparison with fuels with which the natural gas must compete, and not prices we expect to be able to get in industrial use, nor the prices we expect to have to pay in domestic use. The public clamor has been, so far as my memory goes back, for "dollar gas" as applying to manufactured gas and twenty-five cents to thirty cents as applying to natural gas, while if the former is worth a dollar the latter is actually worth \$1.66. Natural gas is a manufactured product. It is not a raw material such as coal and minerals, standing timber, nor even petroleum. It is a thing superior to an exactly similar thing which is to-day regarded as a domestic necessity and is being manufactured in practically every city of any size in this country and sold at prices ranging from \$1 to \$3 per 1,000 cubic feet. It is the one article which Nature has manufactured in past ages and stored in reservoirs ready for use. But Nature has gone out of the gas business and we are confronted with the very distressing fact that when we exhaust the reservoirs the game is up—no more gas is to be had. Natural gas if found in the city of New Orleans, with no investment for pipe line involved, would have an actual value of at least 50 per cent more than artificial gas.

Under the circumstances it would theoretically be an economic crime to use natural gas for any purpose other than those for which artificial gas is now used. It is just as much a violation of the principles of economics to burn natural gas under a steam boiler as it would be to use highly finished lumber as fuel. Unfortunately, however, if the natural gas reservoirs happen to be located far away from the centers of population, the Monroe field being 250 miles from New Orleans, the returns from the sale of it, if confined to the same uses as manufactured gas, will not justify the investment in the field development and the pipe line equipment. Therefore it must of necessity, at least until the original cost of the equipment will have been amortized, be sold for other purposes.

I might enumerate many industries which under these circumstances should use natural gas, but I think they can all be included in the simple statement that where the conditions are as existing here, all users of artificial gas and all forms of fuel other than waste can be legitimately supplied. When, however, the original investment will have been taken care of, or when the supply will have become depleted to a considerable degree, the distribution of natural gas should be confined to domestic consumers, and the price should be so high that none but domestic consumers can afford to use it. The price should also be high enough to prevent the domestic consumers from wasting it. It appears, therefore, from a consideration of the statements I have just made, that natural gas has an actual value far in excess of the figures named by some of our citizens who have had the most to say in the public meetings heretofore held, and who have been the readiest writers for the newspapers. The favorite argument of the speakers and writers of the class to which I refer is that because Shreveport, which is close by the Caddo field, was furnished gas for domestic use at ten cents and lower, and other cities, some of them several hundred miles from the fields, get their gas at from twenty-five cents to thirty-five cents, anybody trying to charge us more than these last named figures was a would-be robber.

In every section of the country when gas is first discovered, not only the public but the quickly formed gas companies, which consist usually of amateurs in the gas business, are apparently carried away with the desire to loot the reservoirs where this wonderful gift of Nature is found, with the consequence that the fields are soon depleted, the companies "busted" and the public left in the lurch. This same sort of vandalism took place in the Beaumont oil fields. Oil was brought to the surface, much of it criminally wasted, and the balance sold sometimes as low as five cents a barrel.

The time for that sort of thing is passed. The state and federal authorities are taking a hand in the conservation of our natural resources, and from now on the influence of these two agencies will be exerted to raise the price of natural gas to the point where the waste of it will be quite expensive to the waster.

When I started my preparations for this paper I conceived the idea that if I could get the New Orleans Gas Company to name a price for distributing gas in the city when delivered to that company by a pipe line company, and if I could get a pipe line company to name a price at which it would deliver the gas to the New Orleans Gas Company, and both would authorize me to make these figures public, this paper containing authoritative statements from both would serve a very useful purpose. While the New Orleans Gas Company was quite willing to co-operate with me in arriving at prices for distribution, I was not able to get them to do anything more than furnish me their costs of distribution over a period of the past few years. Unfortunately the period covered by their report cannot be safely used as a basis because of the great increases in prices, and the uncertainty as to what relation the present prices bear to those which are to apply in the future. I am including, however, in this paper the figures which were given me, and I have ventured to draw some deductions which may be of interest.

As to the general attitude of the New Orleans Gas Company toward natural gas, I have been authorized by Mr. O'Keefe, Receiver of the Railways Company, who is also President of the Gas Company, to say to you that the three propositions which he made the Citizens' Committee appointed some two years ago by the then Mayor Behrman still stand. These propositions were as follows:

> 1st. To sell the gas property to the city at a price to be arrived at by arbitration.
>
> 2nd. To lease the gas property to the city at a rental which would yield a fair return on a value to be arrived at by arbitration.
>
> 3rd. To distribute gas at cost, provided cost was understood to include a fair return on a value to be arrived at by arbitration.

These are fair, square and straightforward propositions, and since they were made at the time Mr. McCormick was offering to bring gas here from Houma, have never been withdrawn and are now renewed, the charge, as frequently made, that the Gas Company has stood in the way of natural gas being brought here ought to be treated as not worthy of consideration.

"Statement showing average gas manufactured daily, also average cost of distribution per M cubic feet sold by years from January 1, 1916, to January 1, 1921, and eight months to August 31, 1921.

	Average Daily Gas Manufactured M Cubic Feet	Average Cost of Distribution per M Cubic Feet
1916	3,910,000	28.26
1917	4,320,000	24.23
1918	4,814,000	31.55
1919	5,370,000	25.41
1920	6,306,000	28.39
*1921	6,086,000	33.95

*January 1 to August 31.

The average cost of distribution per M cubic foot, gas sold, includes distribution, commercial and general expense, also taxes, but does not include any amount for renewals and replacements or return on the investment."

I also have a memorandum from Mr. Kempster, General Manager, giving information as to the changes in burning appliances which he considers as necessary in the event natural gas is substituted for manufactured gas.

> "In the event that natural gas is distributed in New Orleans, it will be necessary to make the following changes in burning appliances as natural gas contains a higher percentage of moisture than artificial gas:
>
> Vent pipes should be installed on all appliances.
>
> The size of the burner holes will have to be increased.
>
> All open grids on gas ranges should be replaced with solid tops, also adjustable orifices should be installed.
>
> It is estimated that it will cost to make these changes approximately $5.00 per appliance."

He also has given me the following memorandum referring to the effect on the volume of consumption that will follow the substitution of low price gas:

> "It is very difficult, if not impossible, to furnish an approximate estimate of the probable effect on the volume of consumption that would follow the distribution of low priced gas; i. e., the distribution of natural gas, at a figure considerably lower than the present price of artificial gas.
>
> The increased use would come mainly in the industrial use of gas. Admittedly, there is a comparatively large field for expansion in this direction, based upon the assumption that the industrial growth of the city will continue."

It would be very desirable, if practicable, to at least form some estimate of the unit price of natural gas delivered to the consumer, but any estimate is extremely difficult, because even with data covering operations past and present the existing conditions are in my opinion abnormal ,and therefore any deductions drawn would be largely guesswork. The price, of course, for domestic gas delivered to the consumer will be the sum of that exacted by the pipe company and the cost of distribution by the New Orleans Gas Company. The unit price for gas is very greatly dependent upon the rate of consumption, up to the capacity of the system, since the fixed charges remain the same and the operating costs do not greatly change with the increase in the consumption.

From an examination of the statement furnished by Mr. Kempster, we find that in the year 1921 the cost of distribution up to a recent date, not including a return on the investment and a charge for renewals and repairs, is 33.95 cents. Mr. Kempster stated that these figures will be greatly reduced by changes in operating conditions now under way. Under the arrangement which we all understand is about to be concluded as between the railways company and the city, the returns on the investment will be 7½ per cent, and the value is to be an agreed value as of a certain date plus the investments in the plant made subsequent to that date, and the figure of $9,000,000, for such value will probably not be far wrong. If we add to the price of distribution for the rate of consumption which applies for the year 1921, namely, about six million cubic feet per day, and allow 5 per cent on the said valuation for renewals and repairs, we arrive at a figure of eighty-four cents in round numbers as the cost of distribution alone. To the distribution figures, whatever they may turn out to be, must be added the price charged by the pipe line company.

In my effort to locate parties contemplating bringing natural gas to New Orleans I was successful only to the point of finding capitalists who are busy investigating the possibilities of the proposition, but who have not yet arrived at the point where they are willing to make public any conclusions which they have reached, and therefore in lieu of the figures which I hoped to get I will quote you from the bulletin of Messrs. Bell and Cattell. These gentlemen state that on an estimated daily consumption of thirty million cubic feet the gas can be brought to New Orleans and sold at 34.65 cents per 1,000. They qualify this statement by saying that while the figures are given merely for the purpose of indicating the possibilities of such a price as an investment, the figures are conservative and believed to be on the side of safety.

The estimate of the cost of the pipe line and its complete equipment, $9,000,000, happens to be the same as the value of the New Orleans Gas Company property taken in my calculation. The gross income requirements for the pipe line is placed by them at \$3,795,000, whereas the requirements of the New Orleans Gas Company, taking the rate of 83.95 and applying to the daily consumption for 1921 is \$1,838,505. The figure applying to the pipe line company includes \$1,095,000 as the field cost of the gas, which deducted from the other figure leaves \$2,700,000 as the income requirements of the pipe line operating company to take care of its operating costs, fixed charges and profit. In the case of the pipe line company the cost is distributed over thirty million cubic feet per day, whereas in the case of the New Orleans Gas Company the cost is distributed over six million cubic feet per day. Assuming that the estimate of thirty million cubic feet per day be attained, it must be remembered that this includes gas for industrial purposes as well as domestic, and that if the distributing company is to handle the industrial distribution as well as the domestic, a considerable investment must be made by the distributing company, since it is not now in position to handle that class of consumer. Moreover, since the life of the gas field is limited, provision must be made in their income for amortizing this added investment.

While the actual value of the gas would justify a distribution charge as high as 83.95, it is not necessary for me to say that no such cost will meet with popular approval. If we take Messrs. Bell and Cattell's figure of 34.65 and add the distribution figure 83.95 cents we have the cost to the domestic consumer at \$1.186. The figures here presented are of course not intended to be accurate and are presented for the purpose of indicating the very great difficulty in the way of a distributing company naming a rate in advance of the actual distribution.

It is quite reasonable to assume that if the unit price for distributing six million cubic feet per day is 83.95 cents, the distribution of even twice that amount, if within the present capacity of the system, would cut this figure almost in half, and judging by the total gas consumption of cities like Dallas, Texas, where on the domestic rate of seventy-five cents the consumption is more than eight million, New Orleans with a population nearly three times as great would very soon build up its consumption beyond twenty million at least, with the consequence of a substantial reduction in price. Unfortunately for the gas problem, consumption depends on price, and cost depends on consumption. Since the consumption cannot be increased above normal except by low price, it seems necessary that the price be below cost in the beginning in order that consumption may be built up to where the cost goes below the price.

At the time the Houma gas proposition was up for consideration a careful analysis of the data available was made, which unfortunately I have misplaced. I arrived at the conclusion that for a field lacking dependability, such as the Houma field, it was not unreasonable for the promoters to include in their price an amortization charge which would retire the cost of a pipe line in four or five years, and with this income consideration and the estimated cost of distribution named to me at that time by the New Orleans Gas Company, from eighty to eighty-five cents was the best price we could expect in the beginning for natural gas from that field delivered to the consumer. While the Monroe field is of such a character that the amortization can extend safely over a period of twenty years, the great additional first cost of the equipment will more than offset this advantage in arriving at a basis of price, and, further, since the costs of distribution by the New Orleans Railways Company have increased very radically since that time, it seems reasonable to conclude that the price of natural gas distributed in New Orleans for domestic use in the beginning of the operations is not likely to be much under ninety cents. It is also reasonable to expect that as the consumption increases—which increase will affect not only the cost of distribution but the cost of the gas as delivered to the distributing company—the price will go lower and perhaps in a reasonable time natural gas may be distributed for domestic use in New Orleans as low as seventy-five cents.

The final conclusion which seems to me justified under all the conditions is as follows:

The pipe line company will build this pipe line if they find that they can compete in this market with oil and coal. If in this competition the coal and oil people have the greater margin of profit they will dominate the situation and the price of gas will be controlled by them, but if, on the other hand, the gas company has the greater margin of profit the price of coal and oil for industrial and domestic use here will be either controlled by the pipe line company or the use of these fuels discontinued wherever gas is available.

The wholesale price of natural gas as delivered to the New Orleans Gas Company will be whatever is the result of the competition.

It is perfectly fair to all concerned that the distribution of gas be done by the gas company at cost, and the final cost to the consumer will be the cost of distribution, whatever it is, plus the wholesale price to the distributing company.

If I have succeeded in convincing you of the importance of educating the people to a realization of the fact that the price of natural gas in the beginning must of necessity be much above their present ideas, and the people with a proper understanding of the matter will grant to the parties considering this proposition friendly co-operation, I think we can safely assume that within a reasonable time we will have natural gas in New Orleans.

DISCUSSION

THE CHAIRMAN: You have heard this very interesting and important paper on natural gas by Mr. Lockett, and I would like to hear some discussion from the members of this Society. We have with us Professor Williamson, who might have something to say.

PROFESSOR WILLIAMSON: I do not know that I can add anything to what Mr. Lockett has said, because he has stated very clearly and very thoroughly the conclusions that were arrived at by Mayor Behrman's Committee of Seventeen, who studied this question, I believe for more than a year. I think he has pointed out very clearly the two salient facts of the situation, namely, the attitude of the capitalists who would have to put up the money if we are to have gas here, and the recognition on the part of the citizens of New Orleans of the fact that they couldn't have natural gas as cheaply as one of the places closer to the field. I think that something impossible to get was conceived by some of the members of the committee at that time. They continually quoted Shreveport at seventeen cents or lower, and some other place which happened to be around twenty-five or thirty cents. When I served on that committee I did not take into consideration, until my attention was called to it, the fact that the oil and coal people would really control the price of gas in one sense of the word. I took into consideration the question of conservation, and it seems to me, in the face of that fact, the actual cost net would be in the neighborhood of eighty cents, from which was to be deducted twenty cents for amortization and five cents for a reserve fund, and in addition thereto the fact that we did not want a repetition in this field of the history of the Beaumont field. Cincinnati was having trouble, and a few months later caused litigation between Virginia and adjoining states as to carrying gas out of those states. In other words, gas was made so cheap when first discovered that the system of the Beaumont fields extended to other fields, with the result that the supply is almost exhausted. That appealed to me more than dollars and cents until my attention was called to the other fact. It is speaking against my own interests for me to say what Mr. Lockett says, that it is criminal to bring natural gas here for industrial purposes. I say that for this reason, natural gas is a God-given product, and not man manufactured, and a private citizen is not able to produce the gas needed for his own consumption, whereas the manufacturer can procure other fuels, and when this gas that is God-given is gone, the consumer is left exactly where he started before he began to use natural gas. For that reason natural gas belongs to the people for consumption. When I say that, I am talking against my own interest, because I am working for the industries. It may be of interest to us to know that our oil will be gone in twenty years, that our timber will be gone in less than fifteen years, and, if not gone, our natural gas will be depleted at the present rate within five or ten years, and it stands to reason that our fifty-five thousand square miles of coal in the South will have to be called into question as we are doing to-day.

I think we are very fortunate to have the facts presented to us, and it is our duty as engineers to try to point out to the people that we are not in an attitude of trying to extract, or getting somebody to extract gas, for I think that is almost as precious as gold to us, and when it is gone it cannot be returned.

The Chairman: We would like to hear from Mr. Thompson, who is with us to-night.

Mr. A. M. Thompson: I would like to place emphasis on one point brought out by Mr. Lockett in his paper, that this is the moral responsibility for the conservation of natural gas. During the year 1919 I was working in the Mid-West section, and it was a common sight to pass through the gas fields and see at night great lights burning continuously, just for the illumination of a country house yard or some such purpose as that. One particular gas jet I have known for a number of years, and watched with interest burn continuously for eight years, simply lighting the front yard of a country residence. I should think it would be a nuisance to burn it day and night. That gas would generate heat enough to run a fairly good sized building for a time. It was a criminal waste for people simply to permit such a natural asset to go to waste in that way. The person owning the land on which this particular well was drilled may not have realized the harm which might have come from the burning of that gas, or the good that might have come in burning it in a more productive way. We are now getting state laws which are expected to correct such extravagances, and I believe every effort should be made, even to the extent made known by Mr. Locflett, to have the price of natural gas so high that it will not be used for purposes which are not justified.

Mr. Lockett: Mr. Chairman, I also stated that the only way you will get natural gas here, however, is to permit its use by industrial plants, because the quantity used for domestic purposes will not justify the investment, and we have got to become reconciled to that until the people who put the money up get it back.

Mr. Thompson: I said criminal for industrial use, because I was on the Gas Commission, and was approached by some people who said, or virtually said, or led me to believe, that they expected the citizens to get natural gas by riding in on the industries; that the industries would get natural gas, and virtually give it to the citizens for almost nothing. That is the reason why I called attention to the fact that this idea must be gotten out of the minds of the people. I expect natural gas to be used by the industries. Shreveport buys their salt cake from Chicago, when they have the salt and sand here in New Orleans.

The Chairman: We would like to hear from Mr. Henning on this matter.

Mr. J. L. Henning: I have the reputation at home of being in the gas business; one of my good friends whom you know very well, insists that I always talk too long when given an opportunity, and he insists that I am in the gas business.

I have read that very interesting report, Bulletin No. 9, and am somewhat interested in the gas situation. When I was connected with a sulphur company, we contemplated building a line from Shreveport, from those fields, and at that time most of our friends advised us that that field would not hold out to justify the building of a line. We were getting fuel oil at that time around something less than a dollar a barrel; in fact I think it was exactly seventy-five cents. That required about twelve and a half cent gas, in fact a little better. That was the figure some of our gas friends gave us, or somewhat less than that.

Mr. Lockett referred to control of the gas by the industrial use; that is absolutely correct. The coal and oil people are not going to permit their business to be taken from them without a very strenuous fight. The price of coal can be very materially reduced in New Orleans when necessity wants it. There are numerous ways of reducing it, and the minute the gas people try to take their business from them you will find reduced coal.

The quantity of gas necessary to justify a pipe line from Monroe to New Orleans mentioned by the pipe line people is rather large. Thirty million feet a day is probably a little more than we found at that time necessary to justify the building of a line, and we were figuring on very much lower prices than the prices mentioned. But no one will build those lines, of course, without that, and the people who build the lines are generally people in the habit of making a large profit on the investment. They would also want to do it with the idea that the gas they had to sell, at a price to compete with oil and coal, would be sold very much lower than the ordinary rate they would charge wholesale to the distributing company. They would want to add a considerable price to the distributing company's cost in order to take care of the uncertainty. I think you mention eighteen cents for industrial consumption. That is probably a figure that would have to be used. I think the industrial gas in Shreveport is somewhere around from twelve to seventeen cents. All the wells in Shreveport have recently had some very serious accidents to them, and it will be only a short time when the people in Shreveport will pay two or three times what they are paying now, and will probably be getting gas from the Monroe field.

MR. OLE K. OLSEN: It is quite a long time since I studied the gas business, and I have not had time to take up the old figures to look them over. I can't add much to what Mr. Lockett and Mr. Williamson have said. In regard to a cost of eighteen cents, I would like to know if Mr. Lockett is taking into account the cost of handling the coal per ton.

Mr. Lockett: I merely made the comparison on the basis of heat units. Of course, that will affect the price.

Mr. Olsen: That will add to the cost of the gas. At the time we were making this investigation we had some propositions made in good faith, and were almost ready to sign up with New York capitalists. We were to start with some eighty-odd cents for the gas, and come down ultimately to forty-eight or forty-nine cents in the course of a number of years. The consumption at that time would amount to somewhere around twenty million cubic feet, if I remember right. That would give us considerably cheaper gas than Mr. Lockett quoted in his paper. It would have been a very good thing if we had accepted the proposition at that time. I think we are going to get the gas from Houma or from Terrebonne Parish when it does come. They are drilling, and when they put down a well they get a good production. I understand that not very long ago they got a very large gas well down there. No doubt there is a great amount of gas coming into that territory. There is a great difference in getting a forty-five mile pipe line and one two hundred or two hundred and fifty miles.

Mr. Lockett: There are men now seriously considering bringing Monroe gas here; they have the money with which to do it. If you inject into the proposition the possibility of getting it from some other field, you will be making a serious mistake, and you are doing a thing I told you was fatal to their proposition.

Mr. Olsen: I was not here at the time you made that statement. I do not think it is necessary to tell those capitalists anything about the Houma field or the Terrebonne field; they know all about it, and I would not be a bit surprised to find that they own the Houma field or the Terrebonne field.

Mr. Lockett: The purpose of this paper is not going to have any effect on the gas line brought here at all. We are trying to produce an effect on the people of New Orleans, so that when the men do come here with a proposition it will not be opposed because some few persons may think the gas could be secured from fields nearer the city at a lower rate. I am in a position to say that there are men figuring on the Monroe pipe line. If they decide that it is an economical proposition, it will be brought here, unless people have an unfriendly attitude towards it, in which event it will be dropped quickly. I think this Society can do quite a lot in bringing about the feeling that will be required to carry out the proposition.

Mr. Thompson: I would like to ask Mr. Olsen if the Terrebonne field is keeping up its record, which is that any well drilled within any reasonable distance of an existing well immediately robs that well. In other words, it becomes an evidence of the weakness of the field, which does not hold in the Monroe field.

Mr. Olsen: I am not in a position to answer that question, not at this time. If I did know it before, I have forgotten it.

Mr. Lockett: With reference to the Houma field, I don't think anything better could happen for the Houma people than to have a pipe line come here from Monroe. It would establish a price for gas. The Monroe people would have to charge a good price for gas. If there is gas at Houma, and they can get it here, they can get a better price than they were getting before. If the line comes from Monroe it will continue west, and it would be easy to keep going with this work in the use of the gas. I don't want to be put in a position as opposing any of these fields, but we have an opportunity to get gas from Monroe here, and I say let us work on that and forget about these other propositions.

Mr. J. F. Coleman: Mr. Chairman, what I don't know about natural gas and the possibilities of gas in New Orleans is a great deal. I have been very much impressed with Mr. Lockett's paper and the business angles of this question, and, in thinking over his paper as he read it, I realized that the citizens of New Orleans, in this particular matter, are as the citizens of any community in any matter involving money, or as individuals are. Every man likes to buy at the lowest value, and wants to sell at the top. That particular peculiarity of mankind accounts in a large measure for the fact that the speculators in the cotton market go broke. They wait for the top price at which to sell. We do have an opportunity, through the means outlined by Mr. Lockett, of acquiring for ourselves a better gas than the manufactured article at a lesser price than we pay for the manufactured article, and it seems to me we are standing in our own light if we fail to take advantage of this opportunity, even though that lesser price may be a higher price than Shreveport, Cincinnati, Indianapolis or some other place has to pay for the same article. So I am very much in sympathy with the proposition of Mr. Lockett that we set about a commercial campaign and disseminate the information we have gathered here to-night among the citizens of New Orleans with whom we come in contact to the end that we might develop a public sentiment which would enable New Orleans to at least improve its present condition in so far as fuel is concerned.

Colonel Dent: There is one question I would like to ask. I understood Mr. Lockett to say that they had to have thirty million cubic feet per day to make the proposition pay. Do I understand that to be the capacity of a single pipe line?

Mr. Lockett: That was taken from a report of an eighteen-inch pipe line, and they figure on a cost of nine million dollars in order to sell it around thirty-four cents, and they would require a consumption of about thirty million feet a day. Of course, it is expected that the line will pick up a number of customers on the way down.

Colonel Dent: That is the capacity of one eighteen-inch pipe line, thirty million feet a day?

Mr. Lockett: Yes, that is the statement of these engineers. They figure on having one pumping plant. You can increase that capacity by having pumping stations along the line. That is merely to give you an idea of what is practicable, and it is nothing definite.

Mr. Ole Olsen: I don't want to be considered a strike-breaker. I want to declare myself willing to try to impress upon the public that if we can't get it from the Terrebonne fields, then get it from Monroe, but let's get it as quickly as possible. I will do all I can to persuade the public to get in, even if they have to pay the price from Monroe.

PROF. WILLIAMSON: While we are trying to sell this idea to the public I would like to point out that with city gas at $1.45 and with natural gas at eighty cents, with an amortization of twenty-five cents, plus five, it costs New Orleans one and a half million dollars a year to continue burning gas at $1.45. In six years' time the people of New Orleans would have saved money enough to pay for a pipe line. That is what it is costing us, about one and a half millions a year to burn manufactured gas instead of natural gas at eighty or ninety cents or a dollar. That million and a half is paid by the people, but they don't realize it, and public sentiment stood against it in spite of the fact that they would pay for the pipe line in six or eight years.

MR. CHAIRMAN: We have with us to-night Mr. Baldwin, of the New Orleans Gas Company, and we would like to hear from him on the subject.

MR. BALDWIN: Mr. Chairman, I am not an official representative of the gas company, consequently I won't speak officially, but I would like, if you will permit me, to speak unofficially. I will say this, that the charge was made that the Gas Light Company is responsible for natural gas being kept out of New Orleans. The Gas Light Company is not only not keeping natural gas out of New Orleans, but is ready to do everything in its power to bring it to the city.

MR. JOHN KLORER: Mr. President, there is only one point upon which I wish to comment. There was something said about fifty-four cents for gas, and fifty-four cents was part of the total cost chargeable to the existing plant. I believe that is the item in the way of getting the friendly attitude of the people of New Orleans. I think the people of New Orleans are unwilling to admit that the plant of the gas company is worth anything like nine million dollars; in fact I believe we have people in authority who think it is hardly worth over five million dollars, and I believe if the gas company was disposed to play fair in the matter of valuation of the plant we would come nearer to a solution than we are.

MR. COLEMAN: I understand a proposition had been made to Mayor Behrman and this committee to turn the plant over to the city on a valuation to be made by disinterested arbitration, and I also understand from reports that there was a proceeding filed by the city against the New Orleans Gas Company for the expropriation of that property. Special masters were appointed by the Court to arrive at what that valuation should be, and those special masters, as instruments of the court for expropriation purposes, did arrive at a value. I have not the figures in mind now, but I am quite sure that the figures, while less than claimed by the gas company, were more than the five million mentioned by Mr. Klorer. The figures they arrived at were something over eight million dollars, I believe. Within the course of the last twelve months I have had occasion individually and professionally to value that plant, or that particular property, and it is my personal conviction, whatever that may be worth, that the value established by the special masters is less than the real value of the property.

THE CHAIRMAN: Gentlemen, the night is still young. If there is any more discussion we will be glad to hear it.

MR. LAWS: How are they going to get that pipe line across the river?

MR. LOCKETT: As I told you in the paper, this is not a technical question. How would you get it across the river? I will ask you that.

THE CHAIRMAN: Mr. Van Horn is here, and we will be glad to hear from him.

MR. VAN HORN: Gentlemen, I didn't come here to speak. I came here to get some information. I have been very pleased, indeed, and I am going to ask Mr. Lockett to let me have his paper so I can read it and get some more information.

THE CHAIRMAN: The paper and the discussion will be published in the Proceedings of the Louisiana Engineering Society, and we hope also in the journal of the American Society of Mechanical Engineers.

THE CHAIRMAW: We have present here to-night Mr. Bleecker, a Director of the New Orleans Gas Company, and we would like to hear from him.

Mr. Bleecker: A requirement of the distributing company in a community is the guarantee of a continuous supply of gas, and a generating plant should not be overlooked. While Mr. Lockett did not directly touch upon this point, I believe, when he allocated certain charges to take care of the existing investment, that he included in those charges the generating plant as well as the distribution plant of the gas company. With a long-distance transmission of gas by a single pipe line, continuous supply would be insured only by having a relay manufacturing plant available at the point of distribution. That, of course, complicates the situation from an operating standpoint, because you then would have natural gas transmitted and artificial gas manufactured as a relay. But those difficulties can, if necessary, be overcome in an emergency, which would be in the event of a break in the pipe line at a river crossing, or something of that kind.

As I understand the "overhead charge" against the gas company, it is based on the present number of cubic feet distributed to get the fifty-four cents. If it were based on the total number of cubic feet which it is estimated would be transmitted through a pipe line costing about nine million dollars, the overhead interest charge would be no more per thousand cubic feet for the existing investment than it would be for the new investment, and my recollection is that that may be far less than fifty-four cents. The lower figure should be the figure borne in mind as the overhead charge, rather than fifty-four cents, which, as I said, is based upon the present distribution of six million feet.

Mr. Lockett: I mentioned in this paper that the returns set out in this paper here by the pipe line company for the cost of gas at the field left an income requirement of two million seven hundred thousand dollars, whereas this very high rate of eighty-four cents only calls for one million eight hundred thousand. So these government engineers are setting out a rate of return far in excess of what the gas company would get, even at the very high rate. Such a rate, I say, is abnormal, and would be very much less than that when they get down to the operation.

Mr. Bleecker: I am not here as a Director of the gas company, Mr. President, to-night. I am here on invitation of one of the members of the Engineering Society, because of my interest in the public state of mind, we might say, which has recently been considered by the Rotary Club through a special committee. The chairman of that committee is not present, and I do not feel like speaking for that committee as to its aims, but my understanding of the aims of that committee is similar to the aim which Mr. Lockett has in reading this paper, namely, the enlightenment or the education of the public of New Orleans to the desirability of securing natural gas, and the explanation to them of those factors which will most likely bring it here.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Board of Direction, October 10, 1921.

The meeting was called to order with President Manley in the chair and the following present: Messrs. Derickson, Lawes, Barelli, Moses and Robert.

Ballots for new members were opened, there being sixty-one formal ballots cast. As a result the following men were elected to the respective grades of membership:

Resident, Mr. A. A. Lanaux.

Non-Resident, Mr. Jules A. Lorio.

Transfer from Junior to Resident, Mr. R. B. Kohnke.

The resignation of Mr. J. A. Commagers was accepted to take effect December 31, 1921.

On motion duly seconded, the following men are to be notified that unless their dues for 1920 are paid by November 1, they will be dropped by the Society as of January 1, 1921.

It having been called to the attention of the Board that Mr. A. M. Lockett, one of our members, was elected Vice-President of the Board of Port Commissioners, it was moved and seconded that the co-operation of the Board and the Society be tendered Mr. Lockett in the solution of the problems relative to the Industrial Canal.

There being no further business to come before the meeting, the same was adjourned.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Society, October 10, 1921.

The regular meeting was called to order with President Manley in the chair and thirty-five members and guests present. The minutes of the previous meeting were read and approved.

There being no business to come before the meeting, the technical exercises of the evening were held and Mr. H. G. Martin, Director of the Delgado Trades School, gave a very interesting lecture on Trade Schools. This lecture was illustrated with lantern slides. At the conclusion of the lecture Professor Williamson introduced the following resolution leading to the endorsement of the Society:

Whereas: The dye and coal tar industries are the key industries to the manufacture ofexplosives, medicinals, and gases for warfare, and

Whereas: The dye and coal tar industries were undeveloped in 1917 to our embarrassment, for explosives, gases, and medicinals, and are yet in their infancy in this country, and

Whereas: Our national security is vested in maintaining and developing our dye and coal tar industries, and

Whereas: O protective tariff in the past has not afforded sufficient protection to allow the establishment of these industries,

Be it Resolved: That the Louisiana Engineering Society endorses selective embargo or selective licensing as protection of these industries that their development may proceed to a point of security.

Upon motion duly seconded this resolution was carried.

There being no further business to go before the meeting, same was adjourned to the usual collation.

JAMES M. ROBERT, Secretary.

Regular Meeting of the Board of Direction, November 14, 1921.

The regular meeting of the Board of Directors of the Louisiana Engineering Society was held, with President Manley in the chair, and the following present: Mr. Riess, Mr. Lawes, Mr. Barelli, Mr. Nelson, Mr. Moses.

In the absence of Prof. James M. Robert, W. B. Moses was appointed acting secretary.

The application of Allen Washburn for transfer from non-resident member to resident, to become effective January 1, 1922, was read and approved.

A letter from John H. Seaman, asking to hold him as a member of the Society until the first of the year was read, and request was acceded to.

President Manley asked that the names of other members to be dropped for non-payment of dues be held over until next meeting of the Board, in order to give an additional chance to bring these members back to the Society.

The financial report of the Secretary was read and accepted.

Prof. Gregory asked the permission of the Board to hold the regular meeting of the Society under the auspices of the New Orleans Section of the A. S. M. E. and same was granted.

There being no further business to transact, the meeting adjourned.

WALTER MOSES, Acting Secretary.

Regular Meeting of the Louisiana Engineering Society, November 14, 1921.

The regular meeting of the Louisiana Engineering Society was opened with President Manley in the chair, sixty-five members and guests being present.

In the absence of Secretary James M. Robert, W. B. Moses was appointed temporary secretary.

Professor Williamson's motion regarding the protection of the dye industry came up for a second reading, and was passed unanimously.

President Manley stated that the Board of Directors had tendered Mr. Lockett, Vice-President of the Dock Board, their co-operation, and in return Mr. Lockett had appointed Mr. Manley, as representative of the Louisiana Engineering Society, on a committee acting in an advisory capacity to the Board.

Professor Gregory reported for the Membership Committee and stated that there were ten new applications on hand, which are being passed upon by the committee at that time.

President Manley announced that the meeting would be held under the auspices of the A. S. M. E., and Professor W. B. Gregory, Chairman of the Local Section, then took the chair to preside over the meeting.

A paper entitled ''Natural Gas for New Orleans'' was then read by Mr. A. M. Lockett. At the conclusion of this paper there was considerable discussion.

Mr. Manley returned to the chair and announced the donation of one hundred and fifty dollars ($150.00) by Mr. Ole K. Olsen, to be used as prizes in a membership drive to be held by the members of the Society. Mr. Olsen was loudly applauded for his commendable action.

Mr. John Klorer, as Chairman of the Library Committee, handed in a report, making recommendation as to new books to be purchased, and asked for suggestions from members. A copy of Mr. Klorer's report will be sent to all members for further suggestions as to additions to Library.

There being no further business, the meeting adjourned to the usual collation.

WALTER B. MOSES, Acting Secretary.