

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY.

CONTENTS.

EDITORIAL NOTES AND COMMENT:	PAGE
Annual Banquet, The.....	5
Annual Outing, The.....	66
Changes of Address.....	214
Chemical Engineers.....	69
Compensation of Engineers.....	171
Contractors' Organization and Equipment.....	205
Corrections, Some.....	72
Cuts for the Journal.....	130
Delegates to the National Drainage Congress.....	212
Dietzgen Employment Bureau.....	289
Ethics of the Contractor, The.....	14
Extra Copies of the Proceedings.....	174
Father of Reclamation, The.....	68
Greetings.....	3
Half-Century of Levee Building, A.....	63
Handling of Freight on Inland Waterways.....	124
Honor to Mr. J. F. Coleman, An.....	71
International Engineering Congress, The.....	285
List of Members.....	15
Material for the Proceedings.....	174
Military Engineering.....	283
Much Debated Question, A.....	211
New Members.....	71, 129, 214, 288
New Orleans Cotton Warehouses, The.....	123
Obituary.....	72
Our New Officers.....	7
Our Advertisers.....	288
Present to Mr. Glenk, The.....	66
Problems of the Contractor.....	170
Reinforced Concrete for Highway Bridges.....	284
Rules and Regulations Governing the Library.....	127
State Board of Engineering Examiners.....	286
Table of Constants.....	128
To Recent Engineering Graduates.....	126
Written Discussion on Papers Presented to the Society.....	125
Your Membership Card.....	64
BOOK REVIEWS:	
Scobey, "The Flow of Water in Open Channels".....	176
Van Ornum, "The Regulation of Rivers".....	216
Haven & Swett, "The Design of Boilers and Pressure Vessels".....	217
Moritz, "Working Diagrams for Irrigation Engineers".....	217
Swain, "Conservation of Water by Storage".....	219
Kent, "Steam Boiler Economy".....	290
Furman, "Valves and Valve Gears".....	290
Goodenough, "Properties of Steam and Ammonia".....	291
PAPERS AND DISCUSSIONS:	
The Ethics of the Contractor, By W. H. Williams.....	16
Discussion.....	37
Forty-Four Years with the Levees in Louisiana, By Major Frank M. Kerr.....	74

Discussion	96
Economic Features Controlling the Design of the Cotton Ware- houses and Terminal of the Port of New Orleans, <i>By Wm.</i> <i>von Phul</i>	131
Discussion	158
A Suggestion for Handling Freight on Interior Waterways, <i>By H. L. Hutson</i>	158
Louisiana State Highways, <i>By C. M. Kerr</i>	178
Discussion	197
Contractors' Organization and Equipment, <i>By Hampton Key-</i> <i>nolds</i>	205
A Spillway Into Lake Borgne, Below New Orleans, and an In- creased Outlet Through the Atchafalaya, as a Means of Flood Relief in Louisiana, <i>By J. P. Kemper</i>	220
Discussion	238, 327
Military Engineering, <i>By A. W. Jackman</i>	292
Discussion	315
A Suggested Form of Construction for Highway Bridges in Louisiana; The Reinforced Concrete Arch, <i>By Donald</i> <i>Derickson</i>	300
LIST OF MEMBERS AND OFFICERS FOR 1914.....	49
MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.	
Minutes of the Board of Direction, December 16, 1914.....	57
" " " " January 9, 1915.....	59
" " " " January 24, 1915.....	60
" " " " February 8, 1915.....	118
" " " " March 8, 1915.....	120
" " " " April 12, 1915.....	164
" " " " May 10, 1915.....	165
" " " " June 14, 1915.....	209
" " " " July 30, 1915.....	279
" " " " September 13, 1915.....	280
" " " " October 11, 1915.....	360
" " " " October 18, 1915.....	361
" " " " November 8, 1915.....	361
" " " " November 22, 1915.....	364
Minutes of the Society, December 16, 1914.....	58
" " " " January 9, 1915.....	59
" " " " February 8, 1915.....	119
" " " " March 8, 1915.....	121
" " " " April 12, 1915.....	165
" " " " May 10, 1915.....	166
" " " " June 14, 1915.....	209
" " " " September 13, 1915.....	281
" " " " October 11, 1915.....	360
" " " " November 8, 1915.....	363
Annual Report of the Board of Direction for 1914.....	112
" " " " Secretary for 1914.....	112
" " " " Treasurer for 1914.....	114
" " " " Library Committee for 1914.....	117
Additions to the Library.....	61, 122, 210, 282, 366

PROCEEDINGS

— OF THE —

LOUISIANA ENGINEERING SOCIETY

VOL. I

FEBRUARY, 1915

NO. I

CONTENTS

EDITORIAL NOTES AND COMMENT:

	PAGE
Greetings.....	3
The Annual Banquet.....	5
Our New Officers.....	7
The Ethics of the Contractor.....	14
List of Members.....	15

PAPERS AND DISCUSSIONS:

The Ethics of the Contractor. Address of the Retiring President. <i>By W. H. Williams</i>	16
Discussion	37

LIST OF OFFICERS AND MEMBERS, 1915	49
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MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY	57
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The Proceedings of the Louisiana Engineering Society

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DOUGLAS ANDERSON, Editor

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Douglas Anderson, Editor, Tulane University,
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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. I

FEBRUARY, 1915

No. 1

EDITORIAL NOTES AND COMMENT

Greetings.—The Louisiana Engineering Society has formally severed its connection with the Association of Engineering Societies and has decided to take up the enterprise of publishing its own journal. This question has been occupying the attention of a number of our members for some time, and the result has been that there has developed a strong sentiment in favor of the change. This finally took practical shape at a meeting of the Board of Directors, held November 9, 1914, when Mr. L. C. Datz and Mr. A. M. Shaw were appointed a committee of two to investigate and report upon the feasibility of withdrawing from the Association and publishing our own journal. At the regular meeting of the Society held the same date a resolution was passed authorizing the Board of Direction to send out notices to the effect that the question would be voted upon at the next regular meeting of the Society.

A special meeting of the Board of Direction was held November 19, and at this meeting the committee of two made its report, which was decidedly in favor of the proposition. At a regular meeting of the Society, held December 16, the question was formally voted upon and the resolution in favor of withdrawal and publication of our own journal was unanimously carried.

This is a brief statement of the history of this movement, and this issue of the journal, which it has been decided to call the *Proceedings of the Louisiana Engineering Society*, represents the initial effort of the Committee on Publication. This committee consists of Douglas Anderson, Editor; Louis C. Datz, A. M. Shaw, Samuel McC. Young, and W. T. Hogg. Bearing in mind the wisdom of beginning with a simple plan and progressing at a rate commensurate with the development of our

resources and material, the committee has decided that for this year at least the journal shall be limited to six issues, to appear in February, April, June, August, October and December.

It is our earnest desire to make the *Proceedings* a publication of great interest to each and every one of our members, not only from the standpoint of the technical papers, but also as a means of keeping him in touch with the activities of the Society. The contents of this number will afford something of the idea of what we hope to be able to offer in each issue both in quantity and quality; it shall be our earnest endeavor in succeeding issues to raise the standard, if possible, both of the quality and quantity. To this end we shall need the hearty coöperation of each and every member; we need more technical papers, prepared for the Society, but now we need them also prepared for the *Proceedings*. We have only about ten meetings during the course of the year, and this naturally limits the number of papers which can be actually read at the meetings; but there is no reason at all why a man should not now prepare his paper to be published in the *Proceedings*, even though it may not have been previously presented to the Society.

The launching of this publication represents one of the most important steps that the Society has ever undertaken, and it behooves each and every one of us, therefore, to realize that its future success or failure will be determined by the amount of coöperation and aid we give it. It should be the means of bringing our members into closer touch with the activities of the Society and with each other as well, and producing thereby a solidarity of feeling among us which will react strongly for the future good of our organization and for the further uplift and development here in the State of Louisiana of the great profession of Engineering. The Editor and his associates upon the Publication Committee realize fully the responsibility which rests upon them for the actual work of getting out the journal, but the spirit and inspiration which will make its pages of interest to you and to others must come from the Society and its activities. If they are virile and full of interest, then the journal should be a success; if not, then the journal must fail from sheer lack of material wherewith to keep it going.

It is our confident belief that it can be made a success, and

this belief is based upon the past record of this organization. This record shows that the Louisiana Engineering Society, with a comparatively small membership, and, consequently, with somewhat limited resources, has always been an active and going concern. Whatever it has undertaken to do in the past has been well done. This means that the spirit of the Society as manifested in the activity and enthusiasm of its members, is one of high ideals and active accomplishments. This in itself is the best augury for the success of this, our new venture.

Those of us who are directly responsible for the work of carrying out this project realize that we shall need all we can get in the way of suggestion and criticism. We shall most heartily welcome both of these, but we do venture to make the request that the suggestions be practical and the criticism, constructive.

And in closing these brief words of greeting, may we beg that every member of our Society will always bear in mind that this journal belongs to him, and it is incumbent upon him, therefore, to give it, to the fullest extent of his powers, that which it most needs—*sympathetic coöperation*.

The Annual Banquet.—This function, enjoyable as it always is, was held January 9, at Galatoire's, in the rooms which by long association have come to seem almost the special property of our Society. There some forty or fifty of our members and their guests assembled in a spirit of good fellowship and conviviality, partook of the good things, both solid and liquid, prepared for us by our host, Monsieur Galatoire; listened to the sweet strains of music, furnished by our old friend of the Celtic name and the Gallie heart, Monsieur O'Connell; and finally felt ourselves uplifted and inspired by the words of wisdom from the lips of the distinguished gentlemen who responded to the toasts proposed by our genial toastmaster, Mr. Coleman. The gentlemen forming the committee responsible for this enjoyable occasion were Messrs. A. M. Shaw, Samuel Young and John Klorer.

The following members of the Society, a number of whom brought guests, were present: Guy Osborne, A. T. Dusenbury, G. W. Lawes, Frank M. Kerr, A. M. Shaw, H. L. Hutson, W. H. Williams, A. W. Jackman, R. T. Burwell, E. H. Coleman, J. F.

Coleman, Samuel McC. Young, Jas. M. Robert, Douglas Anderson, John Klorer, Ole K. Olsen, B. H. Grehan, Marcel Garsaud, J. J. Steadham, H. Kokosky, M. P. Doullut, J. H. Seaman, R. H. Baumbach, W. T. Hogg, Chas. J. Hardy, W. P. Brandin, H. J. Malochee, J. G. Bennett, Wm. G. Koch, John H. Murphy, Ashley Calogne, R. C. Wilson, W. B. Gregory, L. C. Datz, Wade Barnett, A. M. Lockett, Horace Crump, Peyton W. Wood, John Riess.

As the special guest of the Society we had the pleasure of having with us, Major Caples, who has recently come to New Orleans as the successor of Major C. O. Sherrill in the U. S. Engineer's Office.

The date of the banquet this year coincided with the festivities in commemoration of the centennial of the Battle of New Orleans, and note of this was very fittingly taken in the design of the cover of the menu. This consisted of a picture of the Cabildo, so intimately associated with the stirring events of a century ago, and now the home of our Society, in that we have installed our library there and hold our meetings in the assembly hall.

This is the menu to which we were treated:

	MARTINI COCKTAIL	
CELERY		OLIVES
	GREEN TURTLE SOUP	
	TENDERLOIN OF TROUT, WHITE WINE SAUCE	
	BRABANT POTATOES	
		SAUTERNE
	STEAK WITH MUSHROOMS	
	CAULIFLOWER AU GRATIN	
		ST. JULIEN
	DUCK CUTLET	
CELERY SALAD		CHAMPAGNE
	ICE CREAM AND CAKE	
	COFFEE	
CIGARS		CIGARETTES

Mr. J. Frank Coleman acted as toastmaster and in his usual efficient and genial manner kept things going right along in this department. The responses to the toasts were made by the following gentlemen:

First in order came the address of the retiring President, Mr. Williams. This address is printed in full in this issue of the *Proceedings*.

W. B. Gregory responded to the toast, "Our City;" Major Frank Kerr to "Our State;" and Major Caples to "Our Country."

L. C. Datz responded to the toast of "The Incoming Officers."

Mr. H. P. Letton, a guest at the banquet, spoke for "Our Guests."

Our toastmaster announced that he would reserve to himself the privilege of so far departing from the plans and specifications as to call upon certain gentlemen not upon the program. Accordingly, Mr. A. M. Shaw was called upon and he regaled us with some interesting and funny stories. In this same category was Mr. Ole Olsen, who took advantage of the opportunity thus afforded to tell his friends how he had worked a naïve and simple scheme to prevent himself from being elected to the Presidency of the Society.

Douglas Anderson responded to the toast, "The Profession," and Samuel Young brought the evening's entertainment to a fitting close by a graceful and glowing tribute to "The Ladies."

Let us hope that we may all live to enjoy many more such pleasant functions, and that more of our members will learn to appreciate the privilege and pleasure of attending them.

Our New Officers.—At the regular annual meeting of the Society the following officers were elected: L. C. Datz, President; Samuel Young, Vice President; E. Hunter Coleman, Treasurer; W. T. Hogg, Secretary; Ole K. Olsen, to serve as Director for three years. In accordance with our constitution, the retiring President, W. H. Williams, becomes a member of the Board of Direction for one year; and W. B. Gregory and A. T. Dusebury have not yet served out their terms of office as members of the Board. The election of these gentlemen to their respective offices is simply an expression of appreciation on the part of their fellow-members of the faithful and efficient services they have rendered to the Society in various and sundry ways during their connection with it.

A brief sketch of the professional life of each of our present officers is herewith appended:

L. C. DATZ is a native of New Orleans and received his early training in the public schools of this city. After graduation from the High School he entered Tulane University, graduating from the College of Technology, Mechanical Engineering Course, in 1901, with the degree of Bachelor of Engineering. From June, 1901, to February, 1903, he was in the employ of Mr. J. O. Wright, contracting engineer, in the capacity of draughtsman and superintendent; in February, 1903, he became draughtsman and assistant engineer for the New Orleans Railway & Light Company, serving in this capacity until July, 1910, when he accepted the position of Secretary of Tulane University, he being the practically unanimous choice of the Alumni. He remained in this position, however, for only half a year, when he resigned to take up engineering work again, this time with the firm of Ford, Bacon & Davis, in their New Orleans office. From 1912 to 1914, Mr. Datz was with the New Orleans Railway & Light Company in the successive capacities of Engineer of Maintenance of Way, Engineer of Roadway and Superintendent of Overhead and Track. In February, 1914, he became a member of the engineering staff in the New Orleans office of the United Gas & Electric Engineering Corporation.

Mr. Datz was elected to the Society in January, 1906, and has always been one of its most active members. From 1908 to 1911 he was Secretary and Librarian, and was a member of the Board of Direction from 1912 to 1914. Mr. Datz is also a member of the American Society of Civil Engineers, American Electric Railway Association, American Society of Municipal Improvements.

SAMUEL MCCAIN YOUNG was born in Carroll County, Mississippi, and received his preliminary education in the public schools of his native State, finishing his high school at Grenada. He attended college at Washington and Lee University, graduating from there in 1898 with the degree of Civil Engineer. During portions of 1898 and 1899 he served respectively as stadiaman and rodman on United States Deep Waterways Sur-

vey in the State of New York, and as inspector on Yazoo and Mississippi levee. From 1899 to 1902 he was resident engineer on construction for the Choctaw, Oklahoma & Gulf Railroad. For a portion of 1902 and 1903 he was topographer and transitman for the Chicago, Rock Island & Pacific Railroad, after which he spent the following year as engineer in charge of construction of an electric railroad at Scranton, Miss. From 1904 to 1906 he was engaged in the construction of waterworks and electric light plants in various parts of Louisiana and Mississippi. From 1906 to 1908 Mr. Young was locating engineer and division engineer in charge of construction on the New Orleans Great Northern Railroad. The next year and a half was spent at Winnfield, La., upon the location and construction of a railroad and stone-crushing plant for the Southern Mineral & Land Improvement Company. In June, 1909, Mr. Young became a member of the firm of J. F. Coleman & Co. of New Orleans, consulting engineers, and from that time until 1911 was engaged upon work of the various kinds that comes into such an office. From 1911 to 1912 he was constructing engineer for an electric railway in Georgia. From 1912 to date he has been a member of the firm of Guerin & Young, New Orleans, consulting engineers. Upon the resignation of Mr. Bell, Mr. Young succeeded him in the position of engineer for the Board of Commissioners of the Port of New Orleans. Mr. Young is a member of the American Society of Civil Engineers, and became a member of this Society in June, 1911. He was one of the principal advocates of the proposition to move the headquarters of the Society to their present location in the Cabildo, and it was largely through his efforts that the change was made. He has done very efficient service as Chairman of the Library Committee, and put into operation the plan by which the amount of money saved in rental by moving to the Cabildo is now devoted to the purchase of new books for the library.

E. HUNTER COLEMAN, son of Mr. J. Frank Coleman, was born in New Orleans, receiving his early education at the Rugby Academy. He graduated from the College of Technology, Tulane University, in 1911, with the degree of Bachelor of Engineering in the Mechanical-Electrical Course. While a

student, during the summer vacations he acquired practical experience acting as a chainman and rodman for the Beaumont Irrigating Company and for the Southern Pacific Railway. After graduating at Tulane, he spent a year at Cornell University, receiving there the degree of Mechanical Engineer. During the summer of 1912 he was in the employ of the Illinois Central Railroad on construction work at Centralia, Ill., and as draughtsman on valuation at Chicago. Since that time he has been in the office of his father, as draughtsman and inspector upon structural steel work.

Mr. Coleman became a member of the Society in March, 1911, and is now serving his second term in the office of Treasurer.

W. T. HOGG, a native Orleanian, was educated in the public schools of the city and after graduation from the High School entered Tulane University, graduating from there in the Civil Engineering Course in 1913. Mr. Hogg has had practical experience since graduation on topographical survey work at Winnfield, La., and on construction work for the Standard Oil Plant in Baton Rouge. Since graduation he has held the position of Instructor in Civil Engineering at Tulane University.

Mr. Hogg was elected a member of the Society in May, 1914, and succeeded Mr. J. M. Robert as Secretary.

W. H. WILLIAMS was born at Fort McIntosh, in Texas. His father was an officer in the United States Army, and for that reason Mr. Williams' primary school education was somewhat peripatetic in character, he having attended grade schools in as many as ten different States. His high school education was acquired in Detroit, Mich., and in Granville, Ohio. After that he attended the Denison University in Granville, Ohio, taking the Scientific and Civil Engineering Course. His first regular work after leaving college was with the Pennsylvania Railroad in preliminary and location surveys, and construction work on new lines, double tracking and bridges. Following this he was employed with United States engineers on construction of concrete piers and breakwaters at Lorian, Ohio, and on levees in Louisiana. Subsequent to this, he became engineer for

Christie & Lowe, contractors for construction of Southwest Pass Jetties, Mississippi River. Since 1907 Mr. Williams has been a member of the firm of Doullut & Williams, civil engineers and general contractors.

Mr. Williams was elected to membership in the Society in April, 1908. He was Vice President in 1913, and President in 1914. He has always taken an active part in the work of the Society and did very efficient service on the Committee on Entertainment during the recent annual meeting of the American Society of Civil Engineers in New Orleans.

“OLE K. OLSEN.—Born in Copenhagen, Denmark, 1877, a direct descendant from the old Vikings, a caste of pirates who would stop at nothing, from shooting the bull at home to going abroad and stealing a wife or two.

“As a youngster he wanted to follow the trail of his forefathers, but was induced to receive a reasonable amount of civilization in the Polytechnical Academy of his native town.

“After having absorbed as much as his Viking brain could hold of modern engineering science, he took a short, but badly needed, course in the antics of military science which later enabled him to fight his way across the ocean and through the States, landing in New Orleans, January, 1902.

“After having fought to a standstill such enemies as fever, hard luck and persistent creditors, he seems, finally, to have been eminently successful, as is shown from the fact that he was enabled to borrow enough money last summer to go on a visit to his native country. Immediately after his arrival war was declared, and with the old Viking blood still flowing in his veins, he beat it back to dear old New Orleans so fast that there is still a cloud of dust over the ocean.”

(*Editorial Note.*—The Editor requested Mr. Olsen to furnish him a brief statement of the *facts* of his professional life. When he received in response to his request this priceless intaglio of autobiography, he felt it would be like sacrilege to mar its beauty by even one stroke of the editorial pen. He who demands facts may read between the lines.)

ALLAN T. DUSENBURY was born at Homer, Michigan, and received his preliminary education in the public schools of that State, graduating from the Mt. Pleasant High School in 1895. For the next five years he engaged in the business of banking and real estate.

He then decided to take up work in engineering and entered the University of Michigan in 1900, graduating from the Department of Mechanical Engineering in 1904. After graduation he was engaged in the design and manufacture of hydraulic machinery at Battle Creek, Michigan.

Mr. Dusenbury came to Louisiana in 1907 and since that time has been constantly engaged in the work of reclamation and colonization of the wet prairie lands of South Louisiana. He is vice president and chief engineer of the Louisiana Meadows Company of New Orleans.

Mr. Dusenbury has always been active in the affairs of the Louisiana Engineering Society since he was elected to membership in June, 1909. He has been a member of the Board of Direction since 1913.

W. B. GREGORY was born near Penn Yan in the State of New York. He was educated in the public schools and graduated from the Penn Yan Academy in 1890. He entered Cornell University in 1890, graduating in 1894 with the degree of Mechanical Engineer.

Soon after graduation Mr. Gregory came to New Orleans to accept the position of Instructor in Drawing in the Tulane University of Louisiana. He has been connected with Tulane University continuously since that time, rising through the grades of Assistant Professor and Associate Professor to his present position of Professor of Experimental Engineering and Mechanism, which he has held since 1906.

During all this time, in addition to the very active work he has always carried on in his department, Prof. Gregory has done a very large amount of work on the outside in the form of experimental investigations for the United States Government on rice irrigation and kindred topics, as well as consulting engineering work in various fields. As a result of this he enjoys the reputation of being one of the very best authorities in this

part of the country on the subject of pumping machinery. He has written several important bulletins for the United States Department of Agriculture on pumping plant problems and rice irrigation, and has been a contributor to the Transactions of the American Society of Mechanical Engineers, to the Transactions of the American Society of Civil Engineers, as well as to the Journal of the Association of Engineering Societies.

The great variety of Prof. Gregory's professional experience is indicated by the following brief statement:

During the summer vacation of 1902 he was employed by the Navy Department at Washington in the testing of centrifugal fan blowers.

1902-03. Consulting engineer to the Mississippi River Commission in tests on hydraulic dredges.

1903. Summer vacation, agent and expert in rice irrigation.

1905. Appointed irrigation engineer, United States Department of Agriculture, as result of Civil Service examination. During this and the next year made tests of many pumping plants, and during the succeeding summer vacations he has kept up the study of the problems of rice irrigation.

In 1907-08 Prof. Gregory obtained leave of absence from Tulane and went to Cornell, where he took a post-graduate course and obtained the degree of M. M. E.

During 1909 and 1910 he continued his experimental investigations upon drainage problems and made tests upon a number of different plants. During 1912 he was engineer in charge of the reclamation of 5000 acres of wet lands for the New Orleans Netherlands Company. He was also consulting engineer to the New Orleans Lake Shore Land Co. and also to the Port Arthur Rice & Irrigation Co., at Nederland, Texas.

In 1913 he was one of the commission of three engineers appointed to investigate the affairs of the Sewerage and Water Board in this city. He is now acting as consulting engineer to Vaccaro Bros. on a hydro-electric proposition in Central America.

Prof. Gregory is a member of the American Society of Civil Engineers, American Society of Mechanical Engineers, and of the Research Society of Sigma Xi, and is now President of the New Orleans Academy of Sciences.

He became a member of the Louisiana Engineering Society

in July, 1907, was on the Board of Direction in 1909, was President in 1910, and since that time has served continuously upon the Board of Direction. Prof. Gregory has been one of the most efficient members the Society has ever had, and a great many of its best activities have come through his initiative and enthusiasm.

The Ethics of the Contractor.—Elsewhere in this issue of the *Proceedings* will be found Mr. Williams' paper on "The Ethics of the Contractor," which constituted his address as the retiring President of the Society, and which was delivered at the annual banquet, January 9. At the succeeding regular meeting this paper was discussed at length by Mr. J. F. Coleman and Mr. A. M. Shaw, and informally by a number of other members present. The discussion was participated in by members who are consulting engineers, by others who are contractors, and by still others who combine both professions. This question of ethics is one to which a great deal of attention has been devoted by men of all the professions, and after endless debates they all seem to reach very much the same conclusion. In the course of his remarks one of the speakers said that he thought a code of ethics was necessary for the engineering profession in just the same way as the Ten Commandments are for morals. It would seem in most cases of doubt that might arise in the mind of the engineer or the contractor that a brief reference to the spirit of the Ten Commandments, themselves, would probably supply all the ethical principles necessary to a proper decision.

Another point which might also be emphasized in such discussions is the important part played by the owner or promoter in his relations to the engineer or contractor. He is often ignorant of the difference between the consulting engineer and the contractor, and the more he is enlightened and educated along these lines, the less cause will there be for friction between engineers on the one hand and contractors on the other. And the more these two professions come together and thresh out their differences and their difficulties, and try to find some common plane of adjustment, the simpler will become their problems. And just here comes in the great value of a society

like our own, for it provides a common meeting ground for the representatives of these professions, where any man, who really has something to say, will always get a sympathetic hearing and a frank response.

List of Members.—There is published in this issue a complete list of members, and this will be a feature of the first issue of each year. In order to bring this list up to date, post cards were sent out, requesting each member to send in his name, present occupation and address. In cases where no reply was sent to this request the name and address were printed as they now appear upon our files. It is encouraging to note that our membership has now reached a total of 200, this being an increase of seventeen since the last official list was issued. If one will read over this list carefully he will probably be struck with the fact that there is some engineer friend of his whose name does not appear there, and yet by all rights should be there. There can be no more opportune time than the present to bring the Society to the attention of this friend and urge him to become a member.

PAPERS AND DISCUSSIONS

THE ETHICS OF THE CONTRACTOR.

Address of the Retiring President.

By

W. H. WILLIAMS.

For one year now I have been debating with myself as to what the subject of this paper should be; I have hesitated about writing of any work I have performed or have been engaged on for fear that, as I am engaged in the contracting business, the cry of advertising might result; and as, in addition to my being a contractor I am also an engineer, this would conflict with the ethics of the engineering profession; as, during the past few years the profession of Engineering and the business of contracting have become so closely allied and have resulted in the creation of a new profession — Engineering Contracting — I have finally decided to have this paper relate to this business, which I have adopted as a profession, and to which business I am applying such small engineering knowledge as I possess. This paper might be entitled:

Relations of the Contractor with the Engineer,
Contracting as a Business and a Profession,
Relations Between Contractors,
The Engineer as a Contractor,
The Contractor as Designing Engineer, Its Ethical Features and the Result to the Owner, or
The Ethics of the Contractor.
(Personally, I prefer the latter—"The Ethics of the Contractor.")

When I mentioned to a friend that I was thinking of writing a paper on the ethics of the contractor he, figuratively speaking, threw up his hands and said that he did not know that contractors had any ethics. I maintain, however, that contractors

have a code of ethics, as well as have the engineers, doctors, and lawyers. It is neither written nor spoken, but at the same time it exists among the best of the profession and is generally observed, not by all the members of the profession (you will note I say profession, for I contend that in the last few years contracting has become a profession—but that, as Kipling says, is another story) any more than the codes of the other professions are observed by all members.

The word "ethics" is defined by Webster as being a treatise on morals, the science of moral duty, and a system of moral principles.

Some engineers and a part of the general public believe that the entire code of the contractor is summed up in the command, "Get the Money." The unwritten code of the contractor governs his relations with other contractors and with engineers; it dictates the course of the contractor, who is governed by it, when he comes in contact with other contractors in bidding on work; with the sub-contractor, with the engineer in charge of the work, and with the owner. As in the contracting profession, so it is in the other professions—the ethics, whether written or not, are not always observed. There are quack doctors and shyster lawyers. The medical profession and the legal profession both fight the quack and the shyster with every means in their power, and for so doing they are not called "knockers" by the other members of their respective professions, or by the public; on the contrary, they are commended. Why should not the contractor follow the same course, and do everything in his power to eliminate from what has become one of the professions, all who bear the same relation to the contracting business, as the quack and the shyster bear to the medical and legal professions? Should a contractor, who refuses to bid because of such competition as is offered by the contracting quack, be called a "knocker" when he gives his reasons for not wanting to bid? I do not think so. It stands to reason that the contractor who figures on paying for his material and labor and who is morally certain to complete his contract, whether he loses money on it or not, cannot compete with one who may not, or does not fulfill his contract in these respects. Nor can the contractor, who has an organization and established business with its accompanying over-

head expenses, enter, nor should he be required to enter, into competition with a fly-by-night contractor, who carries his office in his hat, who has no organization, plant nor experience, and whose only claim or right to bid on a contract is that he can make bond. In bidding on work it is my opinion that experience and organization should count in awarding the contract, as well as price. It should not be permissible for one with no experience to compete with men who are in the business to stay. I have heard of one instance in an Iowa town, where an undertaker thought that he could make some money in one of his dull seasons; so he bid on some sewer work and got it. I do not know why he selected sewer work to bid on, unless it was that the burying of sewer pipe was nearer to his vocation than any other contract work that offered at the moment. The town finished the work for him, and it cost them considerably more than it would have cost if the work had been given to the highest bidder. The next lowest bidder (and he was only slightly above the undertaker in price) was an experienced contractor in his line.

I do not believe that a legitimate contractor should be expected to compete with one who does not pay his bills, or who, experience has shown, has failed to carry out his previous obligation.

It is a fallacy to always award contracts to the lowest bidder. One does not always purchase the cheapest suit of clothes, or the cheapest machinery.

In a railroad diner the other day, I ordered "Chicken a la Créole," and when I received my order it occurred to me how many different kinds of "a la Créole" I had eaten in as many as twenty different states, and on many different trains. It also occurred to me that in this respect the contracting business closely resembled the preparing of chicken a la Créole. I have noticed that in all my orders, while there was a great variety in the "a la Créoling," there was not a great variety in the chicken. Some had aged greatly before going to their eternal rest, while others had attained their age after death had overtaken them; some had been so trained and exercised during their brief and strenuous career that I, in truth, found them literally the "piece de resistance," so much so that they would resist my every

advance, my every effort to take them unto myself and make them part of me. (Remember that I am now talking about the feathered variety of chicken, and not the other and perhaps better known and liked chicken.) But, as a whole, I have found that with their feathers removed, they would, as a rule, fill the specifications for chicken—the a la Créole was where the variety came in: some chicken was a la Créole because there was a tomato in the dish; some on account of the olive; and some on account of the mushroom; in every case, if it had gravy, it was called “a la Créole;” but in no instance was the a la Créole identical with its predecessors.

It occurred to me that contractors are of almost as many varieties as chicken a la Créole, as some of my engineer friends will testify: some of them are foul without feathers; some are tough, some are old before going into the business, some age after getting into and learning the business; and some are such crooks and scoundrels that they differ only from certain orders of chicken I have had in that the stink would be left after the job was finished, while with the chicken it was noticeable before the work of “a la Créoling” was started.

To a certain extent all contractors are gamblers. The contractor has to be a gambler, because in many specifications that I have seen there is some part of the work that must be done to the satisfaction of the engineer in charge, without any more definition. Who knows what this means? Unless the contractor has done work for the engineer in question, or knows the engineer personally or by reputation, he in many cases is taking a chance every time he bids on work; and even when he has done work for the engineer before, and knows what was expected before, the engineer may have indigestion, where he previously had an A1 disposition, or vice versa. Again, there is a clause in some specifications that might, in some cases, be considered (I have seen it work out so) as compelling contractors to be gamblers. This clause reads somewhat as follows: Any omission from the plans, specifications or other papers attached thereto, and forming a part thereof, or a misdescription of any details of work, the proper performance of which is necessary to carry out fully the general intentions expressed in the detailed specifications of the work, shall not operate to release the contractor

head expenses, enter, nor should he be required to enter, into competition with a fly-by-night contractor, who carries his office in his hat, who has no organization, plant nor experience, and whose only claim or right to bid on a contract is that he can make bond. In bidding on work it is my opinion that experience and organization should count in awarding the contract, as well as price. It should not be permissible for one with no experience to compete with men who are in the business to stay. I have heard of one instance in an Iowa town, where an undertaker thought that he could make some money in one of his dull seasons; so he bid on some sewer work and got it. I do not know why he selected sewer work to bid on, unless it was that the burying of sewer pipe was nearer to his vocation than any other contract work that offered at the moment. The town finished the work for him, and it cost them considerably more than it would have cost if the work had been given to the highest bidder. The next lowest bidder (and he was only slightly above the undertaker in price) was an experienced contractor in his line.

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from performing such work, but the same shall be fully and literally performed in the same manner as if fully and correctly indicated, described and required in and by the contract, and without expense to the owner, in addition to the contract price.

In some contracts of the Corps of Engineers of the United States Army, I notice that a distinct advance has been made in taking some of the risks off the shoulders of the contractor. Formerly, a contractor assumed all the risk until the work was completed and accepted. In a recent specification for some dam work, the Government assumes all risks from natural causes that were unforeseen and could not have been guarded against by the contractor; and these specifications clearly specify that the contractor will be paid for all the material and work lost due to floods or casualties of any kind over which the contractor has no control.

On a previous specification got out by the same office for work done in the same locality, this clause was not inserted and I am informed (I do not know how reliable this information is, however) that under this previous specification a contract was let that was to have taken about one year for completion. This was four or five years ago, and I believe the work is still in an uncompleted state, due to such floods and casualties, and the contractor has been the sufferer.

Is it just that the clause in certain specifications that reads that the decision of the engineer shall be final and absolute should prevail? In a case like this, the contractor is entirely in the hands of the engineer. This is a fine clause for the engineer, who is the judge and the jury and the whole court combined in one. What is the contractor to do? He cannot change the specifications or the contract. The contracts are written by the interested party and given to the contractor for his signature. All he can do is to sign it. There is not much use to even read the contract, so far as there is much chance to change the contract is concerned.

It used to be, and still is to a great extent, that the greatest optimist was the successful bidder. It has not been so very long since estimates of costs were generally guesses, whether made by the engineer or contractor. This condition of affairs has rapidly changed, however, and a realization of the value of

construction costs has been reached. The time has passed when all contractors were "gamblers" and when a contractor took his work purely on a guess, and estimated his profits or losses by the difference in money he had in his pocket on starting and completing his work. Contracting has become a science to a considerable extent. I quote part of an article I recently read, entitled "The Contractor's Place in Society:"

"In this progressive age, when vast projects are being started or finished every week, we hear a great deal about the engineers who plan them, and the capitalist who finances them. The public hears little of the contractor who carries out the ideas of the engineers and architects. The contractor, however, is a very important factor in the situation. He is the man who supplies the brawn and the brain, the equipment and the working capital, to carry the projects to a successful termination.

"It is the contractor who has to perfect the organization which carries on the building of a railroad, a canal, aqueduct, dam or other big project. It is the contractor who has to stand the criticism and the blame when things go wrong; it is the contractor who has to meet and solve the problems which daily arise during the progress of any large undertaking. One of the most delicate and difficult problems which arise in connection with big projects is what is commonly spoken of as the labor problem. The contractor has to face it, and if he is of the old-fashioned non-progressive type, he is likely to have plenty of trouble on his hands.

"The successful contractor does not rely solely on his superintendents and foremen. He does not attempt to run a job from a desk in his office. He is on the job himself as often as he can spare the time and he is familiar with every detail of the work.

"Outside of his business hours, the contractor usually is a prominent factor in the social and civic life of the community in which he lives. He usually is one of the foremost citizens in his community, and takes a keen interest in all movements for social and civic advancement. He is a business man of broad and liberal ideas, as are all men who are doing big things in the world. There is no more honorable calling than that of the contractor who does the big things that make for the advance-

ment of civilization. There is nothing in the life of the average contractor that is spectacular and probably that is the reason that he does not receive as much public notice as some others who are less deserving. A brilliant lawyer or a physician may leap into world-wide fame at a single bound, so with the writer and men in like professions. But the contractor works his way to the top by the dint of his ability and without the praises of the public. If he completes a great piece of work, usually the credit goes to the engineer or architect who designed it, although the contractor is equally entitled to credit.

"Among the men who are doing big things in this world and advancing the causes of progress and civilization, we are ready to take our hat off to the contractor and place him in the front rank. He is an important factor in our national life to-day, although his voice is not heard in the halls of Congress. He is doing the useful and valuable work of the world, and deserves respect and credit."

* * * * *

I do not agree in every detail with the quotation I have just given. As an engineer, I believe that the engineer is entitled to all the credit that is coming to him for work he designs—in other words, for the product of his brain, skill and education. It does sometimes rankle a contractor when he gets none of the credit that is justly his due. I have to acknowledge, however, that my pride in the engineering profession is not lessened thereby, and if you will recognize my inability to write my own thoughts on the subject, you will again permit me to quote from the thoughts of others. This also gives me the opportunity to enlarge on this paper to a greater extent than I would otherwise be capable of.

I quote a paragraph by C. Henry, entitled "The Engineer," which I think we engineers can claim with all modesty does not flatter:

"He is the lord of modern things and times.

"His hand it is that strews the dragon-teeth of courage in the furrows of our dreams: he covers them with warm and passionate labor in the silence of the violet hours when others sleep; in the sweat of his brow he waters them, and in the devotion of his soul he brings them forth into the glamor of To-

day—giant armies of giants, triple-armed to the service of mankind, against which none may prevail save he who brought them into being.

“Where Nature flings a mountain chain to bar the human host from further progress, his is the eye that piercest to the weakest link, and his the hand to guide the furious force that rends the bar asunder.

“He strides across the blazing desert sands where Death has ranged since first the world began; he turns aside the rivers long-league wide, and leads them out across the arid waste to conquer Death and give his wide domains to man.

“The elements are tools unto his craft; with Fire and Water mingled into one he works his utmost will upon the earth. On pinions wrought of canvas and of steel, he wings across the reaches of the air, far swifter than the vengeful winds of Storm can follow him. A thousand times he risks his life, a thousand times he dies; and yet lives on, and ever shall live, until the Universe of things Inanimate shall yield to him its last and utmost store of Good!”



This eulogy on the engineer, though somewhat flowery, has a great deal of truth in it. But how about the contractor who not only follows the engineer, but accompanies him and works with him in the preliminary work, as well as in the actual construction work necessary to the culmination of someone's dreams and the engineer's ideas?

In the beginning of this paper I stated that in the past few years the contracting business has become a profession. This is due to the engineers. You will notice that the largest contracting firms throughout the country are composed of, or are headed by, engineers. The engineers are elevating the profession of contracting. It used to be that “contractor” was a synonym for scoundrel, crook or gambler, but this is gradually getting to be not the case. Some still retain this opinion, however. For instance, I will tell you of a little incident that happened to a friend of mine who is an engineer and a contractor. This occurred in a city not a thousand miles from here. He was attending some social function, and had met all the social lights present. One lady whom he had met on previous occasions, at

like affairs, was present on this occasion. My friend was engaged in conversation with her and a few others. Upon leaving the group, the lady in question turned to another lady (a friend of my friend) and said, "What business is Mr. So-and-so engaged in?" She was told he was a contractor. Great consternation immediately reigned. She exclaimed, "A contractor! Oh, I thought he was a gentleman!"

The big contracting firms are now engineering contractors, and this brings up the question as to whether or not the contractor has the right to design the work, as well as build it; whether he has the right to act for the owner and direct with the owner. At a meeting of the American Society of Civil Engineers, held several months ago, a Code of Ethics was proposed and submitted to the business meeting of the Annual Convention, with the recommendation by the Board of Directors that it be adopted by the Society. As this was published in engineering magazines, I see no reason why I should not quote it:

Code of Ethics.

It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers:

1. To act for his clients in professional matters otherwise than as a faithful agent or trustee, or to accept any remuneration other than his stated charges for services rendered his clients.
2. To attempt to injure falsely or maliciously, directly or indirectly, the professional reputation, prospects, or business of another engineer.
3. To attempt to supplant another engineer after definite steps have been taken toward his employment.
4. To compete with another engineer for employment on the basis of professional charges, by reducing his usual charges and in this manner attempting to underbid after being informed of the charges named by another.
5. To review the work of another engineer for the same client, except with the knowledge or consent of such engineer, or unless the connection of such engineer with the work has been terminated.

6. To advertise in self-laudatory language, or in any other manner derogatory to the dignity of the profession.

* * * * *

At the business meeting of the Annual Convention the question was also brought up and argued to a considerable extent as to whether or not engineers in the contracting business have the right or should act as designing engineer, and work direct with the owner and for the owner, thus throwing out the engineer. Several persons present contended that it was not ethical for the contractors who were engineers to do so. Personally, I believe that contractors who are engineers, and who are engaged in the engineering contracting profession, have every right and are perfectly justified in certain cases, to act direct with the owner and for the owner, instead of through the medium of another consulting engineer. I think, though, that in cases where the contractor prepares and submits the engineering designs and specifications, others should be invited to make bids on the work and that, in the event the engineering contractor who designs the work is not the successful bidder, he should charge the owner with the regular engineer's fees, whatever they may be, for the plans and specifications, with an additional fee in the event that he has to supervise the work for the owner. In a case like this, the engineering contractor really becomes the consulting engineer.

I also think it legitimate that, should the engineering contractor, who designs the work, be awarded the contract for construction, he waive the engineer's fee. This, of course, gives him as the contractor a preference in bidding on the work against other contractors. He gets this preference in return for his knowledge and labor in designing the work.

In this connection it is only fair to give the other side of the question, and I quote one of the arguments that was presented at the business meeting, against contractors acting as engineers:

After the Proposed Code of Ethics had been read, a member spoke as follows: "I would like to differ with this proposed Code of Ethics. It seems to me that the Code of Ethics proposed enables an engine driver to drive his engine right over. It seems

to me to be a Code that will tie the hands of the scrupulous and untie the hands of the unscrupulous. I understand there is a proposition which will enable the Board of Directors to expel a member, very much more easily than it does now, for any unprofessional action. I think it would be very much better to give the Board power to expel a man for any unprofessional conduct than to attempt to tie the hands of all the scrupulous engineers by such an incomplete Code of Ethics as that."

* * * * *

Another member answered this statement in these words:

"I have listened to the discussions read this evening. I studied the Code very carefully on its receipt by myself. I failed to see where that protects the unscrupulous engineer. I see where it takes one first-class dig at that class of engineers who have been a detriment to this Society, before I became a member and since; and I have come in contact with very undignified uses made of the engineering profession by this type—I speak of the contracting engineer.

"These contracting engineers have preached to the people so long that they can get something for nothing that the engineering profession has been thrown down in the dirt and walked on; and I, as a young member of this Society, would like to see a rising up from this downtrodden position here by this class of engineers, who have had very strong control in this Society, and it is very evident to the younger members who have this control. We have been told time and time again 'We don't have to employ engineers.' Bridge contractors, and so on, all the way around, give their services free. If they would write down here, 5, 10 or 15 per cent on this contract is for engineering charges, it would be fair to themselves, and it would be fair to the engineers at large.

"No, they don't do this. They preach to the people that we are giving you these engineering services free. Now, we are going before the people, trying to make them see that the engineers are a professional body of men, and as such they require certain remuneration commensurate with their services. What do you get? The contractor leaves out the part that he is taking in this contract that should be applied as engineering fees.

"The result is that the people look on the engineers the same as the engineers look on themselves. If the engineers do not think themselves worthy of a proper remuneration for their services, how can you expect the body politic to do it? I am sure that I for one would not, unless I was an engineer and knew what the services required. Now that Code of Ethics, as it is written, is detrimental to that class of engineers, and that is the type of engineer that we engineers should either get rid of or so preach to the people and place them in their right position as not representing the profession of engineering. When that is done engineers will come up to the position where they want to be, and be classed by the people as a profession; and until that is done the engineers will be just what they are to-day."

* * * * *

I must ask that you bear with me, and listen to one more argument that was made by another member who spoke on this subject:

"I would like to propose an amendment which I think will cover some of the discussed ground in relation to the engineers and contractors. In my experience and practice in the engineering profession I have found this, when an engineer has tried to play both ends of the game against the middle, as the old saying is, that is, when he has tried to pose both as a contractor and an engineer on the same work, that is all right, if his status is absolutely defined beforehand; but there have been cases in my experience where an engineer has prepared plans for a piece of work, and then has bid on this same work in competition with other contractors.

"Of course, it is evident that such a practice is highly reprehensible, because of the fact that contractors bidding on the work presume that they are all bidding on the same basis, whereas an engineer who has prepared the plans naturally is more familiar with the ideas which he wished to originate, and therefore, to a certain extent he has the advantage, and particularly also he has the ear of the client for whom he has prepared these plans; and I offer this amendment for your consideration after careful study of the proposed Code of Ethics. I am very glad that we are to have a written code, because, while

most of the members of the American Society have heretofore, I am sure, lived up to the unwritten code of the Society, nevertheless we ought to have some definite expression of our practices in relation to our fellow-members.

“The amendment I wish to offer is this:

“‘To bid for construction work in competition with contractors based upon plan and specifications prepared by him as engineer.’

“I do not know whether that is worded as clearly as it might be, but the intent is that an engineer should not bid on work as a contractor, on plans that he has himself prepared for his client in competition. In other words, he should be either one thing or the other. He should be the engineer on that particular piece of work, or he should be the contractor.

“In this amendment I do not wish to bar—and it does not bar—an engineer from doing both the engineering and the construction work, if he does so after an agreement is entered into with the client, but it does bar an engineer from preparing plans and specifications for a piece of work, and then bidding in competition with the contractor; in other words, if an engineer desires also to do the contracting work, he should do so on a basis arranged between himself and a client, and not presume to go into any apparent competition for the sake of getting the job.

“Now a number of the members of the Society might express a doubt that this practice is prevalent. I do not wish to say that it is prevalent, but I do say that it occurs, and it occurs more frequently, probably, than a number of the members of the Society are aware of. I believe this amendment will absolutely define the relation of the engineer as a contractor on any particular piece of work.”

This amendment was defeated.

It will take too much time to enter into a discussion of this argument that was presented at the business meeting of the American Society, but I wish to state that I do not believe it is generally the case that engineering contractors add a charge in their costs to cover the fee for engineering. They are willing to do this engineering work to get the contract, and they let their profit on the contract cover the engineering fees. This is a means adopted to give the engineering contractors a preference

on work over other contracting firms that do not possess an engineering organization, or do not have engineering experience, and who are not as reliable on large engineering contracts. As stated above, however, I believe that every engineering contracting firm should make an engineering charge against the owner, if they have designed the work and do not get the contract for construction.

Look at some of the engineering contracting firms that are in business to-day. Think of the work that is being done by these firms. Snare & Triest have contracts in New York subway alone totalling fifteen millions of dollars; the J. G. White Company have a contract with the Brazilian Government to build a railroad costing fifty millions of dollars; and the same company have a contract with the Chinese Government amounting to thirty-five millions. Another firm I know of just completed work aggregating fifty-two million dollars, in forty-two states. These firms are all of them strictly engineering contracting firms. All of them design and prepare plans and specifications direct for the owner, as well as contract for the work they design themselves. Does it not seem logical that a firm of contractors that is composed of or is headed by engineers should be as well able as another consulting engineer, if not more so, to design work of a character that they are specializing in? Should they not be absolutely expert in preparing plans for work of which they have not only the theoretical knowledge, but also have had the practical knowledge and experience in actual construction? Why, if they have this knowledge, should they not be allowed to apply it? We all know that there are men who hang out their shingles as engineers, and who are retained as consulting engineers to design work that they know only from the theoretical standpoint, and which in many cases requires a practical knowledge. In these cases, if an engineering contracting firm were allowed to design the work, would it not give better results? I am not arguing against high-grade engineers, with years of experience, and with the practical and theoretical knowledge. I do not think that it is the desire or aim of any engineering contracting firm to put themselves in the place of such engineers, or to cut them out of work. I am sure that any of the best engineering con-

tracting firms are only too willing, and in fact would prefer to work by the plans of such an engineer, and under such an engineer; but there are certain cases where it seems preferable, from a practical standpoint, and as much better from a business standpoint, if the engineering contractor should act as the designing engineer, and in many of these cases it is necessary from the business end, in order to get the work, that he do act as the engineer. I do not believe that it is right for a firm without experience in the line that they are specializing in to act in the capacity of engineer for the owner, as I think that the contracting profession should be learned as any other profession before embarking in same, just as is the case with the engineer, the doctor and the lawyer. I know of some cases where better results have been obtained by the contractor who has his own engineering department to design the work, than would have been obtained had the work been handled by the owner through the medium of other engineers of certain types.

Consider the question from another angle. We all know of architects and also engineers who are practicing purely in the capacity of architect or consulting engineers, and yet act as contractors for the owners. I know of many cases where the architect or engineer, as the case might be, acted as general contractor, sub-letting portions of the work to different sub-contractors, and even doing some part of the entire work by labor employed by himself, and by machinery leased from others but operated by himself. If it is right or ethical for the consulting engineer or architect to become the contractor, why the objection to the contractor acting in the capacity of the engineer? Surely, it seems that what is "sauce for the goose should be sauce for the gander."

A few minutes ago I read a quotation eulogizing the engineer. I think I will now hand the contractor his little bouquet, and quote as follows:

"In the course of a speech at the annual dinner of the Contractors' Protective Association in New York, Captain D. L. Hough, President of the United Engineering and Contracting Company of New York, summed up in a few words the qualifications required of a contractor. He said:

" 'There is no class of work that takes as varying qualities

or so many qualities as contracting. It appeals to men who are optimistic and to those who have born in them the longing for doing things. The contractor must be a man, first, possessed of that most uncommon thing, common sense; and he must have physical sense, the sense that tells a man without calculating where lies the center of gravity; the sense that tells a man quantities without measuring. He must have magnetism in order to gather his men about him. He must have a reputation for justice in order to hold them. He must be forceful in order to inspire energy in others. He must be a lawyer and a buyer. He must have the ingenuity of the inventor and the grasp of the field marshal. He must be a diplomat and he must be a politician. He must be a financier, and, I regret to say, in these days, an advertiser; and he must be a prophet.' "

* * * * *

Another clipping I have expresses about the same sentiment in different language:

"As a class you have shown that you are game. You can lose as cheerfully as the best sport and you do not lose your nerve in cases where the average strong arm gent would have a conniption fit. At the same time you need a greater combination of human and practical knowledge of things than any other business man needs."

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The newspapers have a great deal to do with the attitude of the public towards contractors. In almost every notice I have seen about contractors, the papers speak of So-and-So, the "wealthy contractor." From newspaper accounts, every contract is a profitable one—in fact, the contracts on which money is lost are not spoken of. One contractor who had a contract on which he used a very large amount of plant stated that the profit or loss to the contractor was largely a matter of book-keeping, meaning that if he charged anything against the job for plant, the contract would show a loss; and you will find that most contracts come under the same head. I am not talking about political graft contracts of which I have read in the newspapers. Outside of newspapers I know nothing of such contracts. They may, or may not be. The contractor who is in

the profession to stay is, in my opinion, anxious that his work shall be a monument to him, whether the work in question be a ditch or skyscraper. The old-time contractor of the "get the money" class has improved along ethical lines with the general business man, though he has had no pure food laws passed to compel him to toe the mark. Business men the world over, and contractors as well, have discovered that "Honesty is the best policy."

It has been said that there are three kinds of honesty: just plain honesty, business honesty, and contracting honesty, the third being almost unknown. What a reflection on the contractor, in spite of the fact that ninety per cent of the contractors are honest! Why does the public consider the grafter and the contractor as one? Who is to blame? True, the contractor is watched by the engineer and his inspectors to see that he does do honest work, and I think that this is the right method; but I do not think that because there are some dishonest contractors, all should be placed in the same category, any more than all men should be deemed lawbreakers because some few have broken the laws. Some men would lead honest, upright lives, laws or no laws; and some contractors would do honest work, loss or no loss, engineers or no engineers.

The contractor of to-day makes his estimate of the work before him, and adds to his estimated cost an amount to cover his profit. He makes his estimate on the basis of the engineer's plans and specifications, and I maintain that he should, and generally does, give what the plans and specifications call for. If the specifications call for a certain quality of material, he does not figure on using a poorer quality. That is not where he makes his profit. He figures on giving the exact quality of material the specifications call for, and he makes his profit on the saving in labor and in the percentage added for profit. He could make more by slipping in a poorer quality of material, and he could also join the band that makes its profit by hitting unsuspecting citizens on the head with a piece of lead pipe. Contractors, as a class, are not dishonest, though some engineers seem to hold that opinion.

Very often it is the action of the contractor's foreman or superintendent that is the cause of this, and as a result the con-

tractor must stand the blame. Take the case of the superintendent. He wants to do the work as a low cost, so that he will be thought a good man. He finds that the work is running over the estimated cost and, where it may be due to a mistake made by him, he will do his best to put things over on the inspector. Such a man is not only cheating the owner, but he is also making things as hard as possible for the contractor. Suppose that he is caught by the inspector. No amount of explanation will convince the engineer that the superintendent is not acting on instructions from the contractor. Then, there is the foreman who has worked for the old-time contractor—he is a good man, knows how the work should be done, and can get work out of the men under him, still he cannot imagine that there is a contractor living who will not take advantage of the owner if it is possible. You can talk to him time without end and he will promise not to do any underhand work. I had just such a man working for me a number of years ago. He had worked for contractors from boyhood, and at this time was in the neighborhood of fifty years of age. I sent him out on a job to drive piling. Now, very often the smallest part of the cost of the driving of piling is the cost of the actual driving. But, in order to cheapen the cost of the driving, this man cut off from five to ten feet from the piling, and possibly saved five or ten seconds in driving. This saving in driving was more than eaten up in the cost of sawing off, but you see his idea? He was brought up by the old school. Incidentally, I might mention that the inspector found a lot of these ends cut from the piling, and it necessitated my replacing all the piling that had been cut off. I was glad that it was discovered, and that I had the opportunity to make good the damage. At the same time, I was entirely ignorant that such kind of work was being done. I have no hesitancy in mentioning this incident as I do not think it reflects any discredit on me. I have stated this to show that while the contractor does not approve of such proceedings, they are very often blamed on him when he is entirely innocent. However, even if these incidents do happen, the engineer can as a rule rest assured that he will, except on rare occasions, get all the specifications call for; because, generally, I am glad to say even if such malpractice is not discovered by the inspector, it will be found

out by the contractor, who will as a rule make good the damage. These things always come out and in the end they work to the good of the contractor who wants to do the square thing, and eliminates the contractor who is trying to make his money by just such methods.

I have rambled along in this paper taking up a lot more time than I should, and have changed my subjects and have come back to the same subjects after passing them; but I have become so interested in writing this that I feel that I can go along for another hour talking on the contractor and his relation to the engineer.

I feel that I have been peculiarly fortunate during my brief career in that I have had the opportunity to study this question from different viewpoints. I have acted as engineer in the employment of other engineers, as engineer for the contractors, as an engineer in private practice, as inspector on contract work, as engineer for the Government and for railroads, and also as a contractor myself. Consequently, I feel that I have seen all sides of the question, and know pretty well how the engineer and inspector feel towards the contractor, as well as how the contractor feels towards the engineer.

I believe the relations of the contractor with the engineer would be improved if contracting—that is, engineering contracting—was taught as a science by our colleges. If I am correct in saying that contracting is a science, then it can be taught. I believe that it is only a matter of a short time till the leading colleges will offer a course in engineering contracting. This course will not, however, make a contractor any more than a course in engineering will make an engineer. In both cases, it requires practical experience to become proficient. In every business, men of experience, trained men, are a necessity. They are likewise the most difficult to secure and the most expensive. In the contracting business, however, the most expensive men are, as a rule, the cheapest. The largest construction companies are always looking for such men, and such men never look long for a position. Contractors can help along the good work by training men for the profession of contracting. This training should comprise cost keeping and office work, and I believe that the

clerical end of contracting is where most contractors are the weakest.

He should be instructed in time keeping and making up pay rolls, and the paying off of employees. He should be instructed in preparing of estimates of cost, and as to what items should enter into the cost of a piece of work, and under what classification. Acting as material man he will obtain a knowledge of the various materials required and their different grades. He will learn to avoid loss through waste of material, and the importance of keeping a job supplied with material as needed, and the proper care and protection of materials for and on the work. It would take too long to enumerate in detail the various steps that could be taken by a contractor in the training of men for his own staff or organization. A very lengthy paper could be written on this subject alone, and if I had the time I would like to quote at length from a paper I recently read on this subject, and from which paper I have appropriated several points. In order, however, that I may graduate this man I am training, let me rush him through his course. After giving him a thorough experience in the clerical work and as material man, put him on a small job as sub-foreman, then as foreman on jobs gradually increasing in importance. From his experience thus acquired he will in time be able to become superintendent or general manager on larger work. Finally, if the man is any good, he will graduate as a contractor. Every year shows a large increase in the number of engineers who are entering into the contracting business and applying their engineering knowledge to the engineering contracting profession. As a contractor a man must wake up and wake up everybody about him. He must hire and fire until he has a loyal and efficient organization. He must have enthusiasm, confidence and courage, in addition to the training. If he have these four qualities he will be a leader, and that is what I hope each and every member of this Society will become in his chosen line, whether it be civil engineering, mechanical engineering, or contracting.

In closing, I wish to thank all the members of the Society for the support that they have given me in the past year, and again say that the honor was and is appreciated beyond words and too much for me. I can only wish for my successor that

he gets as loyal support and is as fortunate in getting committees composed of as good workers who will accomplish as much for the Society as the committees I was so fortunate in being able to secure.

I thank you.

DISCUSSION ON "THE ETHICS OF THE CONTRACTOR."

J. F. COLEMAN: It is well to have expressions from contractors and contracting engineers dealing with the "Relation of the Contractor with the Engineer," and the writer feels sure that an extended discussion of the questions which must be raised in any such paper as the one under consideration must result in good to the engineer, to the contractor and to the other important class of individuals usually known in contracts as "the owner."

There can be no doubt that all well-intentioned men will agree that it would be well to eliminate the quack doctor, the shyster lawyer, the ignorant engineer, the dishonest contractor; in fact, all of the unworthy in all branches of human endeavor. But speaking in practical terms, all men realize the impossibility of so doing; and no practical man in whatsoever calling has any real expectation of the accomplishment of such an Utopian condition. By sheer necessity we are forced to take the world as we find it and if any man may be able to improve it in howsoever small degree so that when his brief period of activity is closed he leaves things and men better than he found them, he will have justified his existence.

The question raised by the author as to the propriety of considering the bid of the contractor whose office is in his hat, who has no organization, plant nor experience, etc., is one which from the engineers' viewpoint has many angles. Of course if all such cases were as easy to judge as that of the Iowa undertaker there would be no room for argument. Another case illustrating the other side of the question might be cited. A few years ago, a certain young engineer conceived the idea that he could derive more money from contract work than from technical engineering work, and felt that he might also obtain as much or more enjoyment from his labors in that field. He seems to have had the idea that he would prefer working for himself and in his own name than to enter the employ of some contracting organization. He was without money, organization or

while the contractor gives nothing more than his capital and the use of his equipment. Yet the corner stone bears each of their names while the praises of the assistant engineer who actually designed the structure and of the superintendent who actually erected it remain unsung. When the millenium comes these injustices may all be changed, but for the present times this writer does not claim the ability to prepare suitable specifications for the change of condition necessary to rectify this wrong. This is merely one of the conditions which we must meet and each of us can only do his small part according to his lights to improve it.

Another point raised in the paper under discussion is that in regard to the right of contracting engineer to act as both engineer and contractor.

If the interests of the contractor and those of the owner are opposed, as this writer understands them to be, then the position of being both engineer and contractor on the same contract is anomalous. It is easy to understand that an owner might have so much confidence in a contracting engineer as to be willing or even anxious to enter into such an arrangement, and in such a case certainly that is the owner's affair. There can be no inherent wrong in his handling his own money thus if he so elects. It is doubtful, however, in such a case that the contracting engineer can so control his own judgment as not to have it warped (however unconsciously) in some degree by his own material interests. This does not bring into consideration the question of the capacity of the contracting engineer. It may well be understood that some of the most capable engineers of this day are contractors, and frequently no doubt the contracting engineer is a more capable engineer than the chief engineer or consulting engineer whose plans he executes. The question more properly is one of proper protection of the interests of the owner, and in general these interests require the existence and the pressure of a disinterested third party in the position of engineer.

It has been said that "it is human to err," in which saying all can agree. No doubt equal agreement can be arrived at on the proposition that both engineers and contractors are human. It follows that both engineers and contractors do err sometimes.

Let us therefore try and be satisfied with the other fellow

if there is good reason to believe that his motives are good even though we may not fully endorse his views.

A. M. SHAW: The paper which is under discussion this evening would occupy a valuable place in the records of this Society, even though it had not contained much of interest and value as a contribution to literature which bears on the relation between the engineer and the contractor, for it has provoked a discussion which has shown the wide interest which is taken in the relation between these two classes. A lively discussion of a paper is most flattering to the author and it is an end which the writer has unsuccessfully attempted on the two occasions when he has been permitted to appear before this Society with anything of the nature of a prepared production.

Many of the points raised are not easily assailed, such as the undesirability of letting sewer contracts to an undertaker during times of slack business in the caring for the discard of the human race. We are doubtless all agreed, too, that the "chicken à la Créole" has been properly and artistically served by the author and that the honest contractor is not such a *rara avis* as some suppose, but we are not ready to admit the impression given by innuendo, that the expression "wealthy contractor" is not a proper term to apply to contractors in general, for the reason that when a contractor ceases to be wealthy, he *ipso facto* (or *ex parte* or *non compis mentis* or something else like that) ceases to be a contractor.

It will be readily admitted that there are both honest and dishonest contractors and at the same time it must also be admitted, as has already been pointed out in the preceding discussions, that there are both honest and dishonest owners, using the term "owners" in the sense in which it is usually employed in the writing of specifications. It is not at all sure that the average contractor would suffer by comparison with the average owner in this matter of relative honesty, though the dishonesty of the owner is seldom brought out so prominently that it is fully appreciated by any others than the engineer and the contractor (most especially by the latter). I have known contractors who would not hesitate to bury logs and stumps in a railroad fill if they thought that they could do so with impunity.

and I have also known contractors who would spend considerable sums of money in an effort to comply with the spirit as well as the letter of the contract and thus insure a proper structure, knowing that the only remuneration that they would ever receive for the same would be the knowledge of work well done that would remain a credit to them. On the other hand, I have been employed by men or corporations who have instructed me to see to it that contractors should not lose money on contracts which have turned out to be especially difficult to execute and under which a strict interpretation of the contract would mean a serious financial loss if not ruin to the contractor, and I have been employed by others who would attempt to take advantage of penalty clauses of contracts where no just grounds for exacting penalties existed. In fact, one of the most trying positions in which the engineer finds himself is that of a buffer between the contractor and the owner.

The particular point which the author has made, to which the writer desires particularly to take exception, is the matter of writing specifications and preparing of plans by engineering contractors where the contract is to be open to competitive bids. Justification of this practice is attempted by the fact that an amendment to the Code of Ethics, as now adopted by the American Society of Civil Engineers, was defeated, which amendment provided that it should be considered unethical for an engineer to draw plans and specifications and later appear as a bidder on the same piece of work. It is true that this amendment, as well as many others of undoubted merit, was defeated, but it does not follow that the engineering profession as a whole, or even any considerable part, approves of such practice. As a matter of fact, the unwritten code, which will always prove stronger than any mere sets of stipulations or prohibitions, has always provided that no engineer should place himself in a position where he would, or even might, take an unfair advantage of either the owner, the contractor or his brother engineer. In fact, all codes of ethics should stand on a broad interpretation of the Golden Rule, keeping well in mind the greatest good to the greatest number. It is not that some deserving engineer, not a contractor, may lose out on a good fee that the writer maintains that contractors should not draw up plans and speci-

fications which are to be issued for competitive bids, for that would be an attempt toward trades unions practice which does not harmonize with the avowed standards of the profession. Neither is it maintained that under certain special conditions it is not for the general good of a contractor to design as well as execute certain classes of work. He may possess a unique organization, plant and experience which especially fits him to design and execute the work, and these special qualifications may justify the owner in dealing directly with the contractor. It is maintained, however, that if *competitive* bids are desired, the designing engineer should be barred from bidding on the work which he has designed, for he will in most cases, even without attempt to defraud, be taking an unfair advantage, not only of the members of the engineering profession, but also of the owner and of other contractors. To illustrate this by a case which came under the writer's observation, a dredging contract was written by an engineer who was interested in a special style of dredge. The specifications were so written that no other type of dredging equipment could be employed and comply with the specifications. While bids were called for on this work; it could not, by the wildest flight of the imagination, be called a competitive letting. Fortunately for the owner, the bid received was reasonable and the contract was executed in a satisfactory manner. In few instances could such a rare case exist, but the tendency of any designing engineer, who expected later to appear as a bidder, would be to so draw the plans and to so word the specifications that the work would fall within the range of his equipment and organization. This might not result in an unreasonable or extravagant plan excepting that it would throttle competition by introducing certain unnecessary restrictions which would add to the difficulties in executing the work by any other plant or organization. The wise engineer, who conscientiously tries to get the best results for his owner for the least money, canvasses the field of possible bidders and so designs his work that it will be as attractive to these bidders as possible without sacrifice of final results. The question is, will it be possible for the engineering contractor, even though he may have the highest ideals, to secure the same results?

It has become generally recognized by the State, by the

Church and by society in general that the acts of intelligent human beings may not be regulated in minute detail by legislative enactment. The Blue Laws of Connecticut were framed by men who evidently expected to produce a model race, free from all moral blemishes, but we read of the natives of that State whittling out oddly shaped pieces of wood and selling them as perfectly good nutmegs. This could hardly be considered as ethieal, even though not specifically prohibited.

The code of ethics which has recently been adopted by the leading engineering societies of the country and which was quoted in the paper now under discussion is sketchy in the extreme, and wisely so. It has been an open question for years as to whether or not it would be wise to adopt any hard and fast rules of action to be applied especially to the engineering profession. Many have contended that the desired end could better be reached by depending on an unwritten, but more or less generally accepted code which recognizes the fact that the engineer occupies a peculiarly responsible position and that his responsibility does not cease when he has given satisfactory services to his client. This being the case, the engineer should "tote fair," not only with his client, but also with his other associates, the contractor and the brother engineer. It is only by following such a course that he is justified in arrogating to himself the position which we have heard mentioned, that of judge, jury and prosecuting attorney. No class of men can be expected to act fairly in one direction when their material financial interests lie in the opposite direction.

In addition to the written discussions submitted, the following gentlemen were called upon by the President to express their views. The statements here given represent the main purport of their remarks, but are not stenographic reports.

A. M. LOCKETT.—I do not think it is right for a contracting engineer to write the specifications for a project on which competitive bids are to be asked. The engineer who writes the specifications ought not to bid. In our business, we sell pumping plants. Sometimes we offer to construct a pumping plant for a lump sum which includes the cost of the plant and our fees,

and sometimes we offer to construct the plant for the cost plus a percentage for our fees. Further, where we do contract to design and construct, we recommend the purchaser to employ an engineer to inspect our work, because we prefer to deal with engineers rather than with the layman.

JOHN RIESS: I always try to do the square thing toward my client. This seems to me to be pretty close to the sum total of any code of ethics. When a promoter or owner comes to me I always try first to get *his* point of view and to determine just what it is he wants. With regard to the question of the contracting engineer writing his own specifications, I think it is very often necessary for him to do so. For example, architects are frequently called upon to write specifications for classes of work about which they know little or nothing. In this event the architect generally selects some contractor to prepare the specifications for the special line of apparatus which he represents, and the contractor prepares them to his own advantage, rather naturally. Is this right or wrong? I cannot answer the question, myself. I object also to the fact that when people are discussing contractors they always qualify them as simply honest or dishonest. I, for one, object to this sort of qualification.

F. M. KERR: I beg to be excused from the discussion as I have not read Mr. Williams' address. I really only had the pleasure of listening to Mr. Williams' paper at the banquet. . . . My own personal experience with contractors has been very agreeable. I do not think there are any bad scamps among them. . . . I found very few contractors who could not be reconciled to the right thing. I do not think you can regulate morals by a code of ethics, for that reason I voted against the code of ethics of the American Society of Civil Engineers.

RUFUS S. MANLEY: I do not think an engineer ought to write specifications for a job he expects to get. In the event that he is beaten by a competitor, and he is employed as inspector on the job, he may make things very unpleasant for the contractor. I have had considerable experience with municipal engineering contracts. Some municipal engineers take

the view that they are universal judges. I know of one instance where the specifications for a curbing called for a $\frac{3}{8}$ " radius at the top. The contractor used a $\frac{3}{4}$ " radius. The inspector noticed the error, but said nothing to the contractor until the curbing was completed. The contractor laid the case before the City Engineer, and asked him to act as an impartial judge. The City Engineer replied that it was not his place to act as a judge, and he would have to comply with the specifications.

SIDNEY F. LEWIS: My experience has been pretty much confined to levee work. I am glad to see that engineers are going into the contracting business. Specifications always have flaws in them, and when you have to deal with an engineer it is much easier to meet him half way. Any engineer can break a contractor, but it is not right. I always try to help my contractors. Many levee laws require judgment to carry out the spirit of the law instead of the letter. We want good levees, but we must give and take, and that is where the judgment of the engineer comes in.

The engineer must be a gentleman; for it takes a gentleman to discover whether a contractor is a good contractor or a crooked contractor.

MARCEL GARSAUD: I do not see why an engineer should not write the specifications, design and construct a project, provided no competitive bids were intended. There is really no difference between the contractor who designs the work and the engineer who takes the contract on a basis of ten per cent. An engineer sometimes feels it his duty to advise the owner to throw out all bids and have the work done by sub-contractors with the engineer as supervisor.

I am of the firm conviction that a great deal of misunderstanding could be avoided in the drawing up and interpretation of specifications if the engineer would call into consultation several contractors when he is about to prepare specifications for a new project. I know of several cases in which this has been done with great success.

OLE K. OLSEN: While I am a contractor and dealer in building materials and not a consulting engineer, yet I am often forced to act in the latter capacity by my customers and clients. I do not believe we trouble ourselves much about ethics in the steel business. If the owner gets a price that is satisfactory and then gets a good job, is it any of his business how much profit the contractor gets out of the job?

W. H. WILLIAMS: The discussion of my paper this evening seems to have centered itself about the question as to whether it is proper for a contractor to prepare his own plans and specifications. In my paper I dealt with this question from the point of view of the contractor. As far as ability to prepare the plans and specifications is concerned, I believe there are just as able engineers in the contracting business as there are anywhere else, and it stands to reason that in cases where a contractor specializes in certain kinds of work that his engineers will often be more able than the other man to draw up correct plans and specifications. Contractors prefer to work often under the plans of another engineer, but this method is used to secure the work. There are many cases where the contracting engineer is called on to do a piece of work. He contracts to design, write the specifications and construct. The cotton warehouses in our own city is a typical case. The plans and specifications were made by a contracting engineer, this engineer bid on the work and was beaten by a competitor. He then received a fee for his plans and specifications. In our work, we specialize in certain kinds of works, and we feel we are better equipped to make the plans and specifications for structures of those kinds than other engineers who do not specialize. We leave the question of supervising entirely with the owner in case we are not the successful bidder. In the event we secure the work, we make no charge for the plans, specifications and supervision. If we do not secure the work, we charge a fee for the plans and specifications, and for the supervision if the owner desires to employ us as supervisors. Our aim in doing work this way is to save the owner or promoter the cost of engineering fees. We figure our profits cover that charge.

SAMUEL YOUNG: If all engineers were strictly honest it might be all right to let contractors prepare their own plans and specifications and then bid on them. But even under these conditions it would be better to call in a consulting engineer and have the value of two judgments and such suggestions as might be made. Personally, I would not care to bid on plans which I had drawn myself. I disagree with Mr. Garsaud in the case where an engineer undertakes to supervise sub-contract work for a percentage fee. I think that places the engineer in a questionable position. He should get a fixed fee.

H. L. FREEMAN: I believe a code of ethics is necessary for the engineering profession just the same as the Ten Commandments is for morals. Just as the Ten Commandments form a basis for moral conduct, the code of engineering ethics should be the basis for the ethics of the engineer.

JAS. M. ROBERT: In regard to what Mr. Riess said about the architects: when an architect undertakes to write the specifications for a structure, he gets a set of specifications from the plumber, the wiring contractor, the heating company, etc., and combines them into one. It is sometimes asked why he does not go to an engineer for his specifications, and the reason why he does not is because there is no engineer available who can write the specifications he wants except the engineers who have the apparatus for sale.

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 FRANK M. KERR, (C. M.), Chief State Engineer of Louisiana, Board State Engineers, City.
 JOHN KLORER, (1898), Assistant State Engineer, Member of Board of State Engineers, New Court Bldg., City.
 HERMAN KOKOSKY, (1903), Member of firm of Kokosky & Co., 614 Gravier St., City.
 W. P. LANGWORTHY, (1914), Resident Engineer, John A. Kruse Engineering Company, 916 Hibernia Bldg., City.
 G. W. LAWES, (1898), Secretary of Board of State Engineers, State Engineers' Office, City.
 SIDNEY F. LEWIS, (C. M.), Chief Engineer, Board of Levee Commissioners, Orleans Levee District, N. O. Court Bldg., City.
 A. M. LOCKETT, (1900), President A. M. Lockett & Co., Ltd., 533 Baronne St., City.
 GERVAIS LOMBARD, (C. M.), Board State Engineers, City.

HENRY J. MALOCHEE, (1898), District Selling Agent for Alberger Pump & Condenser Co., Nelson Valve Co., Yarnell-Waring Co., American Engineering Co., 314 Perrin Bldg., City.

RUFUS S. MANLEY, (1912), President, Creosoted Wood Block Paving Co., 301 Q. & C. Bldg., City.

SIDNEY L. MENGE, (1909), Manager, Irrigation Dept., Woodward, Wight & Company, Ltd., 430 Canal St., City.

E. B. McKINNEY, (1898), Superintendent of Power, New Orleans Railway & Light Co., 1323 Octavia St., City.

JOHN HENRY MURPHY, (1914), 1322 Felicity St., City.

A. J. NELSON, (), Practicing Engineer and Architect. 2d floor Liverpool & London & Globe Annex, City.

BERNARD S. NELSON, (1911), Engineer with A. M. Lockett & Co., 533 Baronne St., City.

MRS. B. S. NELSON, (1911), 7319 Panola St., City.

ANDERSON OFFUTT, (1908), Consulting and Contracting Engineer for Electrical Installations and Water Works, 439 Carondelet St., City.

OLE K. OLSEN, (1905), Contracting Engineer, 823 Perdido St., City.

J. DEVEREUX O'REILLY, (1912), Civil Engineer, 507 Liverpool & London & Globe Bldg., City.

H. A. PALLFELT, (1914), P. O. Box 532, City.

ARSENE PERRILLIAT, (C. M.), 819 Hibernia Bldg., City.

ALFRED RAYMOND, (1900), City Hall Annex, City.

C. T. RAYNER, Jr., (1909), 2116 Canal St., City.

LYMAN C. REED, (1907), 926 Lafayette St., City.

WARREN B. REED, (1907), Morgan City, La.

HAMPTON REYNOLDS, (1910), 7823 Birch St., City.

JOHN RIESS, (1906), 903 Hibernia Bldg., City.

J. M. ROBERT, (1908), Assistant Professor of Mechanical Engineering, Tulane University, City.

GEO. H. RUGGLES, (1914), with Ford, Bacon & Davis, City.

J. H. SEAMAN, (1912), Salesman in Charge, Westinghouse Electric & Manufacturing Co., 2618 Coliseum St., City.

G. ARTHUR SEAVER, (1911), Office Engineer with Geo. J. Glover, General Contractor, 2011 Marengo St., City.

A. M. SHAW, (1910), Consulting Engineer, 1003 Hibernia Bldg., City.

CHAS. E. SNYPP, (1911), Gretna, La.

ALFRED F. THEARD, (C. M.), Principal Assistant Engineer in charge of Drainage, Sewerage & Water Board of New Orleans, City Hall Annex, City.

J. A. THORNTON, (1911), Morgan City, La.

PAUL UHLICH, (1906), 201 Baronne St., City.

WALTER P. VILLERE, (1909), Board of State Engineers, City.

WILLIAM VON PHUL, (1908), Member of firm of Ford, Bacon & Davis, 921 Canal St., City.

FRANK H. WADDILL, (1898), 407 Tulane-Newcomb Bldg., City.

J. D. WALKER, (1908), Assistant City Engineer, Room 21, City Hall, City.

ALFRED L. WEBRE, (1913), Mechanical Engineer, 643 Magazine St., City.

BEN WILLARD, (1900), Local Manager, General Electric Company, Maison Blanche Bldg., City.

WM. H. WILLIAMS, (1908), Member of firm of Doullut & Williams, Civil Engineers and Contractors, 1016 Hibernia Bldg., City.

THOMAS L. WILLIS, (1907), Principal Assistant City Engineer, City Engineer's Office, City.

VICTOR L. WILLOZ, (1900), Superintendent of Distribution, New Orleans Railway & Light Co., 201 Baronne St., City.

R. C. WILSON, (1911) Consulting Engineer, 4927 Perrier St., City.
 PEYTON W. WOOD, (1911), 201 Baronne St., City.
 A. A. WOODS, (1911), Press and Levee Sts., City.
 W. B. WRIGHT, (1901), Division Engineer, Sewerage & Water Board
 of New Orleans, City Hall Annex, City.
 SAMUEL YOUNG, (1911), Member of firm of Guerin & Young, Consulting
 Engineers; Engineer Board of Port Commissioners, 305 Baronne
 St., City.
 HENRY L. ZANDER, (1898), 821 N. Rampart St., City.

NON-RESIDENT MEMBERS.

WM. E. ATKINSON, (1911), State Highway Engineer, 104 N. O. Court
 Bldg., New Orleans.
 CHAS. D. BABBITT, (1911), Engineer for Gueydan Drainage Commis-
 sion, Gueydan, La.
 C. W. BOCAGE, (1909), Houma, La.
 R. W. BRINGHURST, JR., (), P. O. Box, 192, Alexandria, La.
 HENRY F. CAMERON, (1914), General Manager Lake Charles Railway,
 Light & Water Works Co., care Majestic Hotel, Lake Charles, La.
 JOHN C. DE ARMAS, (1912), Florence, La.
 A. D'HEUR, (C. M.), Vice President and General Manager, Kern Trad-
 ing & Oil Co., 1058 Flood Bldg., San Francisco, Cal.
 LEANDER P. ELBERSON, (1911), Crowley, La.
 FRANK E. EVERETT, (1914), Civil Engineer and Surveyor, Franklin,
 La.
 CHAS. H. FENSTERMAKER, (1914), Elizabeth, La.
 FRANCIS T. FOOTE, (1909), Abbeville, La.
 LOUIS J. FORTIER, (1914), Junior Civil Engineer, U. S. War Depart-
 ment, U. S. Engineer Office, New Orleans.
 C. H. GILLEAN, (1912), 1625 Second St., New Orleans.
 L. H. GUERIN, (1908), 1002 Perrin Bldg., New Orleans.
 W. A. HALLER, (1913), Federal Light & Traction Co., 60 Broadway,
 New York.
 E. S. JARRET, (1909), Consulting Engineer, 71 Broadway, New York.
 EUGENE W. KERR, (1911), Baton Rouge, La.
 XAVIER A. KRAMER, (1911), Magnolia, Miss.
 J. H. LEWIS, (1908), U. S. Engineer Office, Q. & C. Bldg., New Orleans.
 L. A. LOUSTALOT, (1913), Franklin, La.
 THOS. WATTS MADDUX, (1914), Monroe, Mich.
 C. C. MARTIN, (1905), 931 Avery St., Parkersburg, W. Va.
 CHAS. S. McFARLAND, (1903), Burnside, La.
 CHAS. W. OKEY, (1911), Drainage Engineer, U. S. Department of Agri-
 culture, Houma, La.
 WM. C. OLSEN, (1914), Field Engineer, Wilbert C. White, Consulting
 Engineer, 893 Commercial Bank Bldg., Charlotte, N. C.
 GUY OSBORNE, (1913), Donner, La.
 BOYKIN W. PEGUES, (1907), Professor of Civil Engineering, Louisiana
 State University, Baton Rouge, La.
 HENRY NEWTON PHARR, (1908), Olivier, La.
 H. A. PHILIPPI, (1912), Superintendent of Construction, U. S. Engineer
 Office, Vicksburg Drainage District, P. O. Box 421, Vicksburg,
 Miss.
 P. T. PHILLIPS, (1912), Little Rock Ry. & Elec. Co., Little Rock, Ark.
 ALBERT J. PHILLIPS, (1911), 911 West 16th St., Los Angeles, Cal.
 W. B. ROBERT, (1911), Parish Engineer, Opelousas, La.
 R. P. RORDAM, (1911), Inspector, U. S. Engineer Department, Burr-
 wood, La.

JOHN A. SALMEN, (1911), Slidell, La.
 T. H. SAMPSON, (1900), Helena, Ark.
 GEO. SELMAN, (1908), 615 N. 4th St., Monroe, La.
 JAS. SHERRARD, JR., (1910), P. O. Box 62, Ambridge, Pa.
 FRANK SHUTTS, (1909), Lake Charles, La.
 REINIER SWART, (1898), Baton Rouge, La.
 IRA W. SYLVESTER, (1901), Consulting Engineer, Room 5, Rapides Bank Bldg., Alexandria, La.
 W. R. TRIGGS, (1914), District Sales Manager, Buckeye Traction Ditcher P. O. Box 157, Lake Charles, La.
 THOS. H. TUTWILER, (1898), Memphis Railways Co., Memphis, Tenn.
 W. A. VAUGHN, (1912), Reece, Kansas.
 GEO. D. WADDILL, (1911), Junior Engineer, U. S. Engineer Office, Q. & C. Bldg., New Orleans.
 ALLEN E. WASHBURN, (1908), Port Eads, La.
 W. S. WHITE, (C. M.), 918 Parkerson Ave., Crowley, La.
 MAYBIN H. WILSON, (1912), Division Engineer's Office, Southern Pacific Depot, Bakersfield, Cal.

ASSOCIATE MEMBERS.

R. H. BAUMBACH, (1911), Manager, Eugene Dietzgen Co., 615 Common St., New Orleans.
 H. W. FLETCHER, (1914), Manager, Clyde Iron Works, 416 Carondelet St., New Orleans.
 F. CODMAN FORD, (1907), 304 Baronne St., New Orleans.
 JULES GODCHAUX, (1899), Raceland, La.
 BYRON LYONS, (1914), Engineer on Concrete Revetment, Board of Control of New Basin Canal and Shell Road, 1503 Carrollton Ave., New Orleans.
 EDWIN L. POWELL, (1914), Vice President, American Creosote Works, 1531 Exposition Blvd., New Orleans.
 JOHN J. STEADHAM, (1912), Supervisor of Bridges and Buildings, New Orleans & Northeastern R. R. Co., 1228 Music St., New Orleans.
 F. W. STEVENS, (1909), 919 Maison Blanche, New Orleans.
 STILLMAN W. WHEELOCK, (1914), Manager of Sales, Carnegie Steel Co., 1030 Maison Blanche, New Orleans.

NON-RESIDENT ASSOCIATE MEMBER.

S. WALLACE ELBERSON, (1911), with A. M. Lockett & Co., Ltd., Crowley, La.

JUNIOR MEMBERS.

G. C. BADGER, (1913), 3311 Coliseum St., New Orleans.
 EDWARD S. BRES, (1911), Civil Engineer, Orleans Levee Board, 6104 Hurst St., New Orleans.
 ASHLEY CALONGNE, (1914), with S. A. Calongne & Sons, Paving Contractors, 403 Hibernia Bldg., New Orleans.
 A. A. DIETTEL, (1911), with J. F. Coleman, Consulting Engineer, 331 Cherokee St., New Orleans.

GEO. E. DURR, (1914), Head Draughtsman, 2nd Asst. Engineer, General Fire Extinguisher Co., New Orleans Plant, 2200 Canal St., New Orleans.

E. L. EUSTIS, (1911), 410 Audubon Bldg., New Orleans.

D. B. GORE, Vice President and General Manager, D. B. Gore Co., Inc., Contractors and Engineers, 31 American National Bank Bldg., Shreveport, La.

H. M. HAYNE, (1914), 3222 Prytanla St., New Orleans.

WALTER B. MOSES, (1912), 533 Baronne St., New Orleans.

JACOB F. MULLER, JR., (1912), Draughtsman, United Gas & Electric Engineering Corporation, 3731 Canal St., New Orleans.

LEWIS PHILLIPS, (1911), Apartment 3A, 562 West 164th St., New York.

J. E. POCHE, (1911), Chief Draughtsman, A. M. Lockett & Co., Ltd., 1321 Louisiana Ave., New Orleans.

HYMAN RABINOWITZ, (1911), Asst. Engineer, Sewerage & Water Board of New Orleans, 1800 Washington Ave., New Orleans.

DONALD RENSHAW, (1911), 904 Canal-La. Bank Bldg., New Orleans.

EDWIN T. RUSSELL, (1911), 2120 Canal St., New Orleans.

LEO S. WEIL, (1912), In machinery business, Office 309 Whitney-Central Bldg., 5117 Prytanla St., New Orleans.

THOS. WHITE, (1912), American Creosote Works, P. O. Sta. B., New Orleans.

J. NORMAN WILSON, (1911), Asst. Engineer, Sewerage & Water Board of New Orleans, 2823 Dante St., New Orleans.

NON-RESIDENT JUNIOR MEMBERS.

EDW. W. BURBANK, Engineer, Hydraulic Department, Allis-Chalmers Mfg. Co., 1110 Grand Ave., Milwaukee, Wis.

EUGENE M. HORNOT, (1912), Mechanical Engineer, 3418 Chestnut St., New Orleans.

C. L. JACOB, (1911), Engineer's Assistant, The Foundation Co., New York, 892 Falle St., Bronx, New York.

FRED N. SHUTTS, (1913), Lake Charles, La.

BURRIS D. WOOD, (1911), 360 Broadway, New Orleans.

STUDENT MEMBERS.

LOUIS BERNOUDY, (1913), 1018 Music St., New Orleans.

CHAS. H. BROOKSHIRE, (1913), 1217 St. Roch Ave., New Orleans.

JOHN H. BROOKSHIRE, JR., (1911), Asst. Engineer, Sewerage & Water Board of New Orleans, 1217 St. Roch Ave., New Orleans.

JOHN CALLAN, (1911), 1712 Baronne St., New Orleans.

ARTHUR DELBERT, (1913), Chemical and Mechanical Engineer, 4730 Prytanla St., New Orleans.

RALPH EARL, (1913), 1419 Henry Clay Ave., New Orleans.

F. B. ELLIOT, (1911), 1815 Ursuline Ave., New Orleans.

EDWIN J. FISHER, (1913), 2316 Camp St., New Orleans.

J. L. GIACOMINO, (1911), 823 Chartres St., New Orleans.

A. N. GOLDBERG, (1914), 3335 Magnolia St., New Orleans.

BERNARD A. GREHAN, (1914), 3431 Prytanla St., New Orleans.

NORMAN A. HOTARD, (1913), 135 Lavergne St., New Orleans.

WILHELM EMILE KOCH, (1913), 2627 Colliseum St., New Orleans.

R. B. KOHNKE, (1911), Asst. Engineer, Sewerage & Water Board of New Orleans, 8235 Panola St., New Orleans.

PENDLETON E. LEHDE, (1913), 2223 Magazine St., New Orleans.
 HERBERT P. NATHAN, (1913), U. S. Engineer Office, Port Eads, La.
 FRANK POGOLOTTI, (1913), Armagura 23, Havana, Cuba.
 ARTHUR J. SCHMITZ, (1913), 5031 National Ave., Milwaukee, Wis.
 FRANK R. SHAW, (1913), with Ford, Bacon & Davis, Engineers, 4481
 Demontluzin St., New Orleans.
 WILL SMARDON, (1913), Franklin, La.
 FRANK E. SPRAGUE, (1912), 802 Peters Ave., New Orleans.
 LEO STECKLER, (1914), 2007 Baronne St., New Orleans.
 WM. STECKLER, (1913), 2007 Baronne St., New Orleans.
 CLIFFORD H. STEM, (1914), 7933 Poplar St., New Orleans.

SUMMARY.

Resident Members.....	96
Non-resident Members	47
Associate Members.....	9
Non-resident Associate Member.....	1
Junior Members.....	18
Non-resident Junior Members.....	5
Student Members.....	24
Total.....	200

PAST OFFICERS.

Presidents.

Sidney F. Lewis.....	1898	G. W. Lawes.....	1907
Thos. L. Raymond.....	1899	C. W. Wood.....	1908
Henry J. Malochee.....	1900	J. T. Eastwood.....	1909
Frank M. Kerr.....	1901	W. B. Gregory.....	1910
Alf. F. Theard.....	1902	Jas. C. Haugh.....	1911
Alf. Raymond.....	1903	D. S. Anderson.....	1912
J. F. Coleman.....	1904	A. M. Shaw.....	1913
W. B. Wright.....	1905	W. H. Williams.....	1914
W. H. Hoffman.....	1906		

Vice Presidents.

C. H. Chamberlin.....	1898-1899	J. T. Eastwood.....	1908
Alf. F. Theard.....	1900	Jno. Riess.....	1909
J. F. Coleman.....	1901	Jno. Riess.....	1910
W. B. Wright.....	1902-1903	A. M. Lockett.....	1911
W. T. Crotts.....	1904	A. M. Lockett.....	1912
J. M. Ordway.....	1905	Wm. H. Williams.....	1913
G. W. Lawes.....	1906	Ole K. Olsen.....	1914
C. W. Wood.....	1907		

Secretary and Librarian.

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

Treasurers.

Alf. F. Theard.....	1898-1899	J. C. Haugh.....	1908, 1909, 1910
Walter H. Hoffman.....	1900-1901	Jas. M. Robert, Ole K. Olsen....	1911
R. E. DeBuys.....	1902	Ole K. Olsen.....	1912-1913
W. H. Hoffman.....	1903, 1904, 1905	E. H. Coleman.....	1914
J. C. Haugh....	1906-1907		

Directors.

Thos. L. Raymond.....	1898	H. B. Richardson.....	1906-1907-1908
A. C. Bell.....	1898-1899	Jno. Riess.....	1907-1908
F. T. Llewellyn.....	1898	W. B. Gregory.....	1909
Frank M. Kerr.....	1899, 1900	Marcel Garsaud.....	1908-1909-1910
Henry J. Malochee.....	1899	J. W. Armstrong.....	1909-1910
T. H. Tutwiler.....	1900-1901	A. M. Lockett.....	1910
Ernest D. Ivy.....	1900-1901-1902	A. M. Shaw.....	1911-1912-1914
Alf. Raymond.....	1901-1902	L. C. Reed.....	1910-1911-1912
John M. Ordway.....	1902-1903-1904	D. S. Anderson.....	1911
A. C. Duval.....	1903-1904-1905	W. B. Gregory.....	1912-1913-1914
W. McCorkindale.....	1903	L. C. Datz.....	1912-1913-1914
C. W. Wood.....	1904-1905-1906	A. T. Dusenbury.....	1913-1914
E. L. Jahncke.....	1905-1906-1907		

DECEASED.

CHARLES H. DICKINSON, C. M., December 13th, 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.
JNO. 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., April 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.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Board of Direction, December 16, 1914.

The meeting was called to order with President Williams in the chair and the following members present: Messrs. Coleman, Datz, Dusenbury, Gregory, Olsen, Shaw and Hogg.

Minutes of the last meeting were read and approved.

Ballots for the election of members were opened, and the following were elected:

James W. Billingsley, Interstate Bank Bldg., New Orleans, Res. Mem.

George H. Ruggles, care Ford, Bacon & Davis, New Orleans, Res. Mem.

Wm. C. Olsen, Lock Box 400, Washington, N. C., Non-Resident Member.

Stillman W. Wheelock, 1030 Maison Blanche, New Orleans, Ass. Mem.

H. M. Hayne, 3222 Prytania St., New Orleans, Junior Member.

Leo Steckler, 2007 Baronne St., New Orleans, Student Member.

A. N. Goldberg, 3335 Magnolia St., New Orleans, Student Member.

Clifford Stem, 7933 Poplar St., New Orleans, Student Member.

The vote was unanimous, 31 formal ballots were cast, and 9 informal ballots.

Mr. Marcel Garsaud addressed the Board as a representative from the State Board of Examiners for Civil Engineers. Mr. Garsaud stated that a rumor had reached the Board of Examiners that the Governor was contemplating appointing an entire new Board from the list submitted to the Governor by the Society, October 8, 1914. Mr. Garsaud stated that it was not the intention of the Board of Examiners in drawing up the new Act 200 of 1914 to create an entire new Board. The Secretary was instructed to furnish Mr. Garsaud with a copy of all our correspondence relating to the matter in question. Mr. Garsaud was appointed to look into the matter and report to the Board of Direction with recommendations.

The resignations of Messrs. E. C. Barker, Alexander Allison, Jr., Sidney L. Menge, J. W. Armstrong, A. G. Levy, Charles H. Davis, were read and accepted.

The following bills were approved:

Searcy & Pfaff, Ltd., binding 15 volumes.....	\$18.75
F. Daubert, refreshments.....	9.00
Kokosky & Co., books for library.....	8.76
Tulane Press, printing and stationery.....	35.45
W. T. Hogg, Secretary, salary and incidentals.....	

The Secretary rendered a statement of the Library account, which showed a balance of \$164.16 December 1, 1914. The Secretary was instructed to charge the cost of magazine subscriptions and binding to the Library account instead of the General Fund, as formerly done.

There being no further business, the meeting adjourned.

W. T. Hogg,
Secretary.

Regular Meeting of the Society, December 16, 1914.

The meeting was called to order with President Williams in the chair and twenty-five members present.

The minutes of the last meeting were read and approved.

President Williams reported that the Board of Directions had recommended the proposed withdrawal from the Association of Engineering Societies. Mr. Marcel Garsaud moved that the Society vote favorably on the recommendation of the Board of Direction. The motion was seconded by Major Kerr and carried.

Ballots were then cast for the nomination of officers for 1915, as follows:

For President.			For Vice President.		
	1st Bal.	2d Bal.		1st Bal.	2d Bal.
L. C. Datz.....	8	12	J. Riess.....	2	
O. K. Olsen.....	9	8	S. Young.....	8	12
S. Young.....	2		J. Klorer.....	3	4
J. Klorer.....	1		M. Garsaud.....	3	3
	—	—	O. K. Olsen.....	2	
	20	20		—	—
				18	19

For Treasurer.			For Secretary.		
	1st Bal.	2d Bal.		1st Bal.	2d Bal.
E. H. Coleman.....	12		W. T. Hogg.....	17	
J. Riess.....	3		O. K. Olsen.....	2	
J. Klorer.....	2			—	
O. K. Olsen.....	2			19	
	—	—			
	19				

For Director, 3-year Term.

	1st Bal.	2d Bal.
O. K. Olsen.....	9	11
A. M. Shaw.....	5	6
J. Klorer.....	2	2
M. Garsaud.....	1	
J. Riess.....	1	
	—	—
	18	19

It was moved and seconded that the President appoint a Banquet Committee for the Annual Banquet in January. Messrs. Young, Shaw, and Klorer were appointed.

There being no further business, the meeting adjourned to the col-
lation.

W. T. Hogg,
Secretary.

Annual Meeting of the Board of Direction, January 9, 1915.

The meeting was called to order with President Williams in the chair and the following members present: Messrs. Coleman, Datz, Dusenbury, Gregory, Olsen, Shaw and Hogg.

Minutes of the last meeting were read and approved.

The annual reports of the Secretary and Treasurer were submitted and accepted.

The resignations of Messrs. Alexander Allison, J. T. Bullen, and E. H. Bowser were read and accepted. The resignations of Messrs. Walter B. Moses and Jno. L. Porter were ordered laid over. The matter of dropping the members delinquent for 1914 dues was laid over to the next meeting.

The following bills were approved:

F. Daubert, refreshments.....	\$24.00
W. T. Hogg, Secretary, salary and incidentals.....	

There being no further business, the meeting adjourned.

W. T. Hogg,
Secretary.

Annual Meeting of the Society, January 9, 1915.

The meeting was called to order with President Williams in the chair and forty-five members present.

The minutes of the last meeting were read and approved.

The annual reports of the Board of Direction, the Secretary, and the Treasurer were submitted to the Society.

The report of the Library Committee was read and approved.

The Secretary reported, with regret, the loss of our fellow-member, Mr. J. C. Henry of Natchitoches. Messrs. Ira W. Sylvester and Marcel Garsaud were appointed on a committee of two to draw up resolutions on the death of Mr. Henry.

A communication from the Association of Engineering Societies in reply to our notice of withdrawal was read. The text of the letter was contained in an editorial in the December issue of the Journal. It was moved, seconded and carried, that the President be directed to communicate with the Chairman of the Association, informing him that we had withdrawn from the Association, December 31, 1914.

Ballots for the election of officers for the ensuing year were opened. Forty ballots were cast, as follows:

For President—L. C. Datz, 39, Ole K. Olsen, 1.

For Vice President—Samuel Young, 40.

For Treasurer—E. H. Coleman, 39.

For Secretary—W. T. Hogg, 40.

For Director—Ole K. Olsen, 39; L. C. Datz, 1.

The vote for Vice President, Treasurer and Secretary was unanimous.

There being no further business, the meeting adjourned to the annual banquet.

W. T. Hogg,
Secretary.

Special Meeting of the Board of Direction, January 24, 1915.

The meeting was called to order with President Datz in the chair. Messrs. Coleman, Dusenbury, Olsen, Williams, Young and Hogg were present.

Minutes of the special meeting of the Board, December 23, 1914, were read.

President Datz stated that the object of the meeting was to reconsider the list of names submitted to the Governor on October 8, 1914, and to have Mr. Marcel Garsaud explain Mr. Waddill's position in the matter and the reason for his resignation from the Board of Engineering Examiners. It was moved, seconded and carried, that Mr. Waddill's name be placed at the head of the new list to be submitted to the Governor. A new list of names was drawn up, as follows:

F. H. Waddill, Tulane-Newcomb Bldg., New Orleans.

B. W. Pegues, Louisiana State University, Baton Rouge, La.

Donald Derickson, Tulane University, New Orleans.

Ira W. Sylvester, Alexandria, La.

J. T. Bullen, P. O. Box 772, Shreveport, La.

Francis T. Foote, Abbeville, La.

A. C. Bell, 5224 Coliseum St., New Orleans.

J. Devereux O'Reilly, Liverpool & London & Globe Bldg., New Orleans.

There being no further business, the meeting adjourned.

W. T. Hogg,
Secretary.

**Additions to Library Since the Publication of the Abridged Catalogue,
December 1, 1914.**

Reinforced Concrete Construction, Vol. II—Hool.

Logarithms—Vega.

Am. Ry. Engr. & M. of W. Assn. Bulletin No. 108, February, 1909.
Containing Report on Masonry.

The Library will receive regularly the proceedings of the following
Societies:

North Dakota Society of Engineers.

Western Society of Engineers.

PROFESSIONAL CARDS

Guerin & Young

ENGINEERS

305 BARONNE STREET

NEW ORLEANS

PROCEEDINGS
—OF THE—
LOUISIANA ENGINEERING SOCIETY

VOL. I

APRIL, 1915

No. 2

CONTENTS

EDITORIAL NOTES AND COMMENT:

	PAGE
A Half-Century of Levee Building.....	63
Your Membership Card.....	64
The Annual Outing.....	66
The Present to Mr. Glenk.....	66
The Father of Reclamation.....	68
Chemical Engineers.....	69
New Members.....	71
An Honor to Mr. J. F. Coleman.....	71
Some Corrections.....	72
Obituary	72

PAPERS AND DISCUSSIONS:

Forty-four Years with the Levees in Louisiana. 1871-	
1914. <i>By Major Frank M. Kerr</i>	74
Discussion	96

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY	112
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New Court Building.
E. H. COLEMAN, Treasurer, 920 Hibernia Building.
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A. T. DUSENBURY, 901 Maison Blanche Building.
OLE K. OLSEN, 823 Perdido Street.

The headquarters of the Society are in the State Museum
Building, Jackson Square.

Address all business communications to W. T. Hogg, Secretary,
P. O. Station 20, New Orleans, La.

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PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. I

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EDITORIAL NOTES AND COMMENT

A Half Century of Levee Building.—While forty-four years may fall a bit short of the half century mark, still the many interesting experiences set forth in Major Kerr's reminiscent narrative of his long and distinguished services to the State of Louisiana in this most important branch of her public works, might well have covered a much longer period of endeavor under other conditions, which would not impose upon the engineer such extremely active and strenuous duties as those involved in the task of keeping the great Father of Waters within proper bounds.

And when two such experienced veterans in the service as Major Kerr and Col. Lewis get together in a discussion of levee building, one may feel absolutely certain that he is being presented with the best information, technical and historical, upon this matter of such vital importance to the City of New Orleans and the State of Louisiana.

After all, a levee seems a rather simple affair,—“just dirt, and then more dirt,”—but, as Major Kerr's paper shows, we have arrived at this simplified form through a long period of trial and ultimate rejection of many fads and fancies, such, for example, to mention one of the most striking illustrations, as that of the weatherboard fence running longitudinally through the middle section of the levee. And that “dirt, and then more dirt” is the one and only thing desirable in a levee cannot be doubted in the least when one has heard Col. Lewis's gentle animadversions upon the characters of people and corporations who insist upon spoiling this very effective simplicity by such obnoxious devices as water-supply pipes laid through the base

of the levee. But still more reprehensible is the conduct of the political pseudo-inspector, who so far neglects his duty as not to require the contractor to plough the base, this neglect resulting in the failure to discover an old pipe, which "lays low" until time of high water and then proceeds to make trouble for all parties from the Chief Engineer down.

And while it may be a far cry from the days of the old Louisiana Levee Construction Company to these days of levee district, State and partial Federal control, there still remains another important step forward in the line of progress. This step will be taken when the National Government recognizes its full responsibility in the matter and assumes complete control of the great Mississippi River problem, not only in that phase of it bearing upon navigation, but as well in the more serious task of protection of the surrounding country from overflow. No doubt when this time does come and this important step is taken, the people of the Mississippi Valley will see to it that there shall be written into the records of such men as Major Kerr, Col. Lewis, their associates and their predecessors, that meed of praise, than which none greater has ever been expressed.—"Well done, thou good and faithful servant."

Your Membership Card.—At the beginning of the year there is sent to each member a little card which is a sort of certificate, and tangible evidence, of his membership in the Louisiana Engineering Society. It seems wise to call attention to the privileges to which this membership entitles the holder in addition to those with which we are familiar here at home. Printed upon the back of this card will be found a partial list of the engineering clubs and societies, similar to our own, with which we exchange house and library facilities. The list up-to-date is given herewith:

American Road Builders' Ass'n., 150 Nassau St., New York.
American Waterworks Ass'n., 47 State St., Troy, N. Y.
American Wood Preservers' Ass'n., Baltimore, Md.
American Society of Civil Engineers, 220 West 57th St., New York.

American Society of Mechanical Engineers, 29 West 39th St., New York.

Boston Society of C. E., 715 Tremont Temple, Boston, Mass.

Brooklyn Engineers' Club, 117 Remsen St., Brooklyn, N. Y.

Cleveland Engineering Society, 413 Chamber of Commerce, Cleveland.

Detroit Engineering Society, 614 Moffat Bldg., Detroit, Mich.

Engineers' Club of Baltimore, 4-6 W. Eager St., Baltimore, Md.

Engineers' Club of Dayton, Dayton, Ohio.

Engineers' Club of Minneapolis, Minn., 17 South Sixth St.

Engineers' Club of Philadelphia, Pa., 1317 Spruce St.

Engineers' Club of St. Louis, 3817 Olive St., St. Louis, Mo.

Engineers' Club of Toronto, 96 King St., West, Toronto, Can.

Engineers' Society of Pennsylvania, 31 S. Front St., Harrisburg, Pa.

Engineers' Society of Western Pennsylvania, 2511 Olivier Bldg., Pittsburgh.

Idaho Society of Engineers, Boise, Idaho.

Maine Society of Civil Engineers, 487 Union St., Bangor, Me.

Montana Society of Engineers, Butte, Mont.

N. Dakota Society of Engineers, University, N. D.

Pacific Northwestern Society of Engineers, 312 Central Bldg., Seattle, Wash.

Rochester Engineering Society, 135 Sibley Bldg., Rochester, N. Y.

Technology Club of Syracuse, Vinney Bldg., Syracuse, N. Y.

Utah Society of Engineers, Consolidated Music Hall, Salt Lake City, Utah.

Western Society of Engineers, 1737 Monadnock Block, Chicago, Ill.

Ohio Society of Mechanical, Electrical and Steam Engineers, Ohio State University, Columbus, Ohio.

As may be observed from this list, it covers a majority of the important cities throughout the country. Many of these societies, particularly those in the larger centres, have very commodious quarters with all the facilities of a modern club, and in addition meeting rooms and technical libraries for carrying on

the special work of the society. Your membership card entitles you to the use of these facilities whenever you may happen to be in a place with whose local society we exchange privileges.

With the active co-operation of all our present members in building up the membership of this Society, it would not be unreasonable for us to look forward to the time when we, ourselves, could afford to have quarters more centrally located, as well as providing some of the features of the modern club. This is certainly a goal worth keeping ahead of us.

The Annual Outing.—It has been the long-established custom of this Society to have an annual outing at some time during the summer months. This function has heretofore taken the form of an excursion to some locality in which there was a manufacturing plant or some engineering project, an inspection of which would prove a source of interest and instruction to our members. It would appear that we have now about exhausted the possibilities in this direction, and it therefore seems not out of place to suggest that we try the plan of making our next outing a social affair, pure and simple. After all, one of the chief values of this function is the opportunity it affords us of becoming better acquainted with each other.

The specific suggestion is that we secure the new Steamer Hanover and go off for a day's picnic across Lake Ponchartrain and up the Techefuncta River. The Hanover has a commodious dining saloon, a well stocked cafe, comfortable rooms for the ladies, and last but not least, a fine dancing floor on the main deck. Surely the Louisiana Engineering Society numbers among its members enough expert tango artists and one-steppers to make things lively for our wives and sweethearts, who always go along. If this suggestion meets with favor, it would be wise to appoint a competent staff of designing and consulting engineers in order that plans and specifications may be drawn, and contracts let to the proper parties.

The Present to Mr. Glenk.—It is doubtless well known to most of our members that we are located in our present quarters, which we use free of rent, through the courtesy and hospitality of

the State Museum Board. This privilege was obtained through the kindly and active co-operation of Mr. Robert Glenk, Curator of the State Museum. Mr. Glenk has been untiring in his efforts to make us feel at home and to make things as comfortable as possible for us. In consideration of Mr. Glenk's courtesy and kindness, Mr. Young of the Library Committee proposed that we show our appreciation of the same in the form of a present. Accordingly a fund was raised with which was purchased a handsome silver platter, and this was sent to Mr. Glenk.

The following letter has been received from Mr. Glenk and read before the Society:

Mr. L. C. Datz, Mr. John Reiss, Mr. Saml. Young, Committee
and Members Louisiana Engineering Society, New Orleans:

Gentlemen—I cannot adequately express to you my surprise and gratification upon receiving the beautiful silver platter which you have sent me as a mark of your appreciation of my feeble efforts to provide a cheerful and satisfactory domicile for your Society in the State Museum Building.

I accept the gift gladly and tender you my cordial thanks for this evidence of your good will.

You must remember, however, that the satisfaction of having your Society comfortably located is not all yours, as the Board of Curators is justly proud of the fact that you have accepted our hospitality at the State Museum. We appreciate the fact that it is an honor to the Institution to have such an influential and representative body of men to take up their domicile with us, and it is your privilege to make use of whatever facilities we can offer you, and which we will at all times gladly extend without any feeling of obligation on your part.

We trust that our relations in the future will continue to be intimate and as satisfactory as they reasonably can be expected to be.

Again thanking you for your courtesy, I remain,

Very truly yours.

ROBERT GLENK,

Curator, La. State Museum, Jackson Square.

The Father of Reclamation.—Edward Wisner, who by common consent here in Louisiana has had conferred upon him the title of Father of Reclamation, died at his home in New Orleans on the morning of Monday, March 9th. While Mr. Wisner was not a member of the Louisiana Engineering Society, he was so closely identified with engineering interests and his extensive reclamation projects did so much for the engineering profession in this State that it seemed fitting and proper that this Society should take some official notice of his death. Accordingly at the regular meeting of March 9th, a committee was appointed to draft appropriate resolutions, and this committee brought in the following report:—

Whereas the life of Edward Wisner has been so largely devoted to the development of the resources of the State of Louisiana, and

Whereas this has brought him into frequent and close contact with the engineers of the State;

Be it resolved; that the Louisiana Engineering Society has learned with regret and sorrow of the death of Mr. Wisner, and that its members feel that the engineers of the State have lost a public spirited citizen whose pioneer work in the reclamation of the waste lands of the coast has marked the way for adding untold wealth to his adopted State;

Be it further resolved that a copy of these resolutions be forwarded to his family, and that another copy be spread upon the minutes of the Society.

A. M. SHAW,
W. B. GREGORY,
J. M. ROBERT,
Committee.

Mr. Wisner was born on his father's farm, near Athens, in Calhoun County, Michigan. He was so limited in his early educational opportunities that he was able only to go through the grammar grades. He more than made up for this, however, in his incessant and enthusiastic efforts to educate himself, and as a result of his constant work and study at home he soon won for himself a position as a teacher in the schools. His health not being equal to this confining work he gave it up and took a trip

to the South, during which he had opportunity to become acquainted with the resources of Louisiana. After this visit he decided to settle in Louisiana and accordingly in 1892 he transferred all his business interests to this State.

He established a bank at Delhi, purchased five thousand acres of land in Louisiana, and engaged in the timber and cotton business. He lost very heavily during the panic of 1896, and had practically to begin his business life over again. It was then he began to take a more active interest in the wet lands of this State and in the problem of reclaiming them by drainage. He made a careful study of land reclamation in foreign countries, and this subject became almost the gospel of his life. So effectually did he preach it to his friends that he was soon able to enlist sufficient financial support to go into the project of buying up these wet lands on a large scale. In a comparatively short time he had acquired considerably over a million of acres of such land in the parishes of Terrebonne, Lafourche, Jefferson, St. John, St. Charles, Plaquemine and St. Bernard. Some of this land was bought as low as $12\frac{1}{2}$ cents per acre. Mr. Wisner was president of the Louisiana Meadows Company, which was organized for the purpose of carrying out the engineering operations such as digging drainage canals and erecting pumping plants, necessary for the reclamation of these lands. It was this work which brought him into close contact with the engineering fraternity, and he had a number of warm personal friends in this Society, who will mourn his loss sincerely.

Mr. Wisner was only fifty-five years of age at the time of his death, and, except for the specific affliction which was the immediate cause of his death, was in the prime and vigor of his life. The Louisiana Engineering Society feels that it is honoring itself in thus paying this tribute to the character and worth of this public spirited citizen, who in a comparatively short period has done so much for the development of the material resources of the State of Louisiana.

Chemical Engineers.—About the time this journal goes to press there will convene in New Orleans the Annual Meeting of the American Chemical Society. Though the complete official

program is not yet ready for publication it is understood that a very large portion of it will be given over to problems of Industrial Chemistry. This is an age of such extreme specialization that the field of engineering is divided up among a large number of different societies, each dealing with some special branch of engineering science, and each holding its conventions and publishing its own journal of proceedings. And yet they are all animated by the same purpose and are all working on the same great problem in its differing phases, viz.: the economic utilization of the resources of nature in the advancement of civilization. Of all these many divisions of engineering there is none more important than that of Industrial Chemistry. We used to call the practitioners of this profession chemists, or analytical chemists, but now we call them chemical engineers.

Too much stress cannot be laid upon this important branch of engineering to the whole South, and more particularly to the State of Louisiana. One is too apt to think of Louisiana as merely an agricultural State, and yet one of the most prominent of her crops is of such a nature as to require the skilled services of a chemical engineer for its harvesting and conversion into the staple ready for the market. And while Louisiana's industries are largely agricultural, yet she is at the same time one of the richest States in what are ordinarily termed mineral products, such as salt, sulphur, petroleum and natural gas. The proper production and utilization of all of these things is the function of the chemical engineer.

To young men who are attracted to the profession of engineering the advice may be wisely given to look carefully into the opportunities offered in the line of Industrial Chemistry. The many problems there presented, such as the reduction of waste in manufacturing processes, the utilization of by-products, the efficient combustion of different fuels, etc., etc., are of such a nature as to require a high degree of training both in the principles of Chemistry and of general Engineering. This need for highly trained engineers of this type is being recognized more and more by our technical schools and they are all using every effort to offer the best possible courses in Chemical Engineering.

The importance, therefore, of this meeting of the American

Chemical Society to our city and State cannot be over-estimated. nor to ourselves as members of the various engineering professions; for it must necessarily have a strong influence upon the matter of bringing to the attention of the outside world the natural resources of this locality, thereby inducing more capital and more industrial enterprises to come this way, all of which means more prosperity for the engineers.

New Members.—The following applications for membership in the Society have been acted upon favorably by the Board of Direction :—

For Resident Membership.—Mr. M. S. Sloan, General Manager of New Orleans Railway & Light Co.

Mr. Samuel J. Dill, Vice-President United Gas & Electric Engineering Corporation.

Mr. Eugene F. Delery, Engineer New Orleans Sewerage & Water Board.

Mr. Robert J. Titzel, Gas Engineer, United Gas & Electric Engineering Corporation.

Virgil A. Eberly, Engineer with U. S. Lighthouse Service.

Arthur M. Scott, Engineer with Ole K. Olsen.

H. P. Porter, Engineer with A. M. Lockett & Co.

For Non-Resident Membership.—Mr. Fred N. Shutts, Parish Engineer, Calcasieu Parish.

For Junior Membership.—Mr. Herbert P. Nathan, Graduate, Class 1914, Tulane University of La.

For Associate Membership.—Mr. Roger B. Quincy, Engineer with Robert W. Hunt & Co.

The Editor trusts he may be able to publish a list like this, or even larger, each issue.

An Honor to Mr. J. F. Coleman.—It gives us great pleasure to record here the fact that Mr. J. F. Coleman was elected a Director of the American Society of Civil Engineers at the meeting held in New York City, January 20. Mr. Coleman is one of the two directors elected to represent the Sixth District of the Society, which district comprises the States of Virginia, West

Virginia, North Carolina,, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas, New Mexico, Arizona, Mexico, the West India Islands, Central America, and South America.

Some Corrections.—The Editor begs to make the following corrections in the February issue of the PROCEEDINGS with the proper apologies in each case.

In the report of Mr. W. H. Williams' discussion of his own paper, on page 47, he was made to say that the plans and specifications for the cotton warehouses in *this* city were made by a contracting engineer, this engineer bid on the work and was beaten by a competitor. This should have read "The cotton warehouses in *Galveston*."

On page 10 it was stated that Mr. W. T. Hogg was educated in the public schools of New Orleans and at the Boys High School. This was an error as Mr. Hogg received his preliminary training at St. Paul's College in Covington.

In the list of members on page 52 Mr. W. B. Wright was indicated as having joined the Society in 1901. Instead of this Mr. Wright was a charter member, dating from 1898.

OBITUARY.

Mr. J. C. HENRY of Natchitoches, a prominent non-resident member of this Society, died at his home December 12th, 1914, in the fifty-fifth year of his age. He was born at Baxter plantation, Natchitoches Parish, December 8th, 1859. His early education was received in the schools of his native parish, and he afterwards attended the Virginia Military Institute, where he graduated with high honors in the course in Civil Engineering. Returning to his home after graduation he engaged in the practice of his profession and also took up farming as a side line. In 1884 he was married to Miss Emeline Gaiennie of Natchitoches who died in 1910. Five children of this union are still living, three daughters and two sons. Mr. Henry's second wife was Miss Eugenie Himel of St. James, and she and one son survive him.

Mr. Henry took a prominent part in fraternal organizations and was a member of the Knights of Columbus, Woodmen of the World and Knights of Pythias. He spent practically his whole life in his native parish and was always a progressive citizen, taking great interest in civic affairs, and was always prominent in any movement for the upbuilding and improvement of his town. At the time of his death he was a member of the State Legislature and was City Engineer for the town of Natchitoches, as well as Engineer for the Parish of Natchitoches. He had been a member of the Louisiana Engineering Society since 1908.

FORTY-FOUR YEARS WITH THE LEVEES IN LOUISIANA.

1871-1914.

By

FRANK M. KERR.

[Read before the Society, March 9, 1915.]

From 1871 to 1877, that is, during the dark days of carpet-baggism in Louisiana, all levee building was, practically, done by the State, through a Board of State Engineers, composed of three members, a Chief and two Assistants, the work performed being payable from a general State Tax of three mills on the dollar on the assessed valuation of the State at large.

The members of this Board of State Engineers were intended by law to be Civil Engineers, experienced in and qualified for the exercise of their profession in all its branches, the Chief receiving a salary of Six Thousand, and the Assistants of Three Thousand Dollars each, per annum.

Remarkable to credit to those days, the Chief Engineer selected, General M. Jeff Thompson, familiarly known, during the Civil War, as the "Swamp Fox," *was* a Civil Engineer of marked ability and experience.

General Thompson occupied this position until his death in 1876, when he was succeeded by A. F. Wrotnowski, also a Civil Engineer of accepted qualifications.

General Thompson was quite a character in many ways, besides proving to be an exceptionally acceptable engineer. He was, too, if anything, quite original.

As an instance of this, it may be related that, in his report to the Governor of the State, upon the high water of 1874, occurs the following:

"So great had grown the tension at to what next to expect, that, upon the morning of April 17th, when three more great crevasses were reported, I could not help exclaiming: 'Yes, and I feel like a woman delivered of triplets, and their names are Morganza, Hickey and Bonnet Carré.'"

To the list and names of the Assistant State Engineers serv-

ing' during this time with these Chiefs, it would weary you to listen.

Their selection, appointment, term of service and disappearance was on the order of the lightning change artist in a continuous vaudeville performance, governed by the humor of the powers that were and the political exigencies of the hour.

Thus, one day, one or more of them would be a bankrupt country merchant, or a "has-been" farmer or planter; another day, an ex-Congressman, or a "shyster" lawyer out of a job, or a space writer of carpet-bag persuasion; and, at one time, *one* of these so-called Assistant State Engineers, and Member of the then Board of State Engineers, was a negro cabinet maker—but seldom, if ever, a civil, or any other kind of engineer.

It would be invidious, if not uncharitable, at this late day, to give names in connection with the members, other than the Chiefs, of this Board of State Engineers, especially as every solitary single one of them has long since "shuffled off this mortal coil." Their names are, however, still very fresh in my memory.

It might not prove amiss, however, to recall by name some of the more creditable sub-assistants employed at the time to make up for the short-comings of this Board of State Engineers.

Among these, there stand out most prominently, favorably and agreeably in my mind, A. F. Wrotnowski, W. C. Melvin, T. A. Washington, Benj. McLeran, C. Uncas Lewis, John V. Van Pelt, and last, but by far, not least, H. Bolivar Thompson.

To go back to the Board of State Engineers itself, by tacit agreement between the Chief Engineer and his Assistant State Engineers, the latter, as a general proposition, presented themselves at the office as seldom as possible, usually but *once* a month, to draw their salaries, but, in no manner, shape nor form to otherwise concern themselves about anything.

Thus, in order to carry on the duties and work of the Department, the Chief Engineer had to have recourse to the employment of as many sub-assistants as appropriations would permit, picked from about the most efficient engineers of that day, of which, the writer is frank to say, there was really quite an astonishingly good field.

Among the lesser lights in this field, your humble servant made his debut as an "Assistant to Engineers," or the man just *one* grade higher than the stake—fresh from L. S. U., armed with a sheep-skin (the real thing), assuring an unsuspecting and gullible public that another "Civil Engineer" had been ruthlessly sprung upon it.

The man just higher in grade than the stake is, you know, the guy in the survey party who has nothing left but the poor innocent stake upon which to wreak his vengeance after each one in turn above, from the Chief of the party down, has successively "cussed out" the man below him.

In connection with this Board of State Engineers, the following Departments, to assist in carrying out the laws of the time regulating levee building and administration, were in force: the Executive Department; the "Commission of Engineers"—(three members, one representing the United States, one the State, and the other the Louisiana Levee Company—salary of each \$6,000.00 per annum); the "Commission of Persons" (Three members as before, with same salaries); the "Louisiana Levee Company," and, of course, the Auditor of Public Accounts and the Treasurer of the State.

The Louisiana Levee Company was a regularly chartered institution granted the sole privilege of building the levees of the State at a stated price per cubic yard, which, during the earliest period of its existence, was at the rate of sixty (60) cents per cubic yard, no matter what the location or dimensions of the levee might be—in open land, or timber, four feet or forty feet high. The price later on was, by mutual agreement, reduced to fifty cents per cubic yard.

The Governor of the State was "King of all he surveyed," which covered every Department of the State, and every individual in its hire, of high or low degree.

It was the duty of the Commission of Engineers to visit each locality and determine upon and prescribe the location and dimensions of the levee to be built. The Commission then notified the Board of State Engineers of its conclusions in the premises, and directed a detailed survey to be made and lists of dimensions and specifications to be furnished to the Louis-

iana Levee Company for the construction of the levee. The Board of State Engineers then, through its forces, made the surveys, setting stakes, and giving all necessary instructions. Upon these instructions the Louisiana Levee Company built, or sub-let for construction, the work, its engineers, some three or four, superintending it during construction. When completed, the Board of State Engineers was so notified, when another inspection, measurement, etc., followed, and certificates issued by that Board to the Louisiana Levee Company, upon which to settle with its sub-contractors, and as data for the Commission of Persons, upon the certificates of which latter body, the State, through the Auditor of Public Accounts and the Treasurer of the State, settled with the Louisiana Levee Company.

It was intimated by some cruel critic of the times that all this rather savored of circumlocution, but the "circumlocutors" virtuously disclaimed that, by thus multiplying the number of checks, they were exhibiting anything more than zeal for the State's welfare in insuring it against false measurements and estimates.

To the "man up the tree," however, it looked more like a wholesale raid on the State's finances in the interest of a horde of hungry office seekers, whose patriotism to the cause of the day, political or otherwise, could not otherwise be aroused and depended upon.

In connection with the engineers of the Louisiana Levee Co., it must be recorded that they in every way outclassed those of the then Board of State Engineers, including such notable names as Caleb G. Forshey, at one time principal assistant to Humphreys & Abbott in the preparation of their admirable work on the physics and hydraulics of the Mississippi River, and afterwards an honored educator in the great State of Texas; G. W. R. Bailey, noted railroad engineer of the day and principal adviser to Jas B. Eads in the construction of the Jetties at South Pass; John V. Van Pelt, Henry B. Richardson, T. S. Hardee, Henry Goodrich, M. W. Darton, William H. Williams, and others, all too well known to need extolling by me, and it was the writer's fortunate privilege, very shortly after entering the employ of the Board of State Engineers in 1871, to succeed in being trans-

ferred to the engineer corps of the Louisiana Levee Company as Private Secretary to the then Chief Engineer, Col. Forshey, and general draftsman, occupying those positions until the abrogation of the contract between the State and the Louisiana Levee Company, in 1877; then again becoming identified, as Chief Draftsman, with the reorganized Board of State Engineers, under the administration of Governor Francis T. Nicholls.

With reference to the Commission of Engineers, and the Commission of Persons, the Louisiana Levee Company was represented by the Chief Engineer of the Company, the State and the United States, at one time, and then another by political henchmen of the party of the day, such as B. B. Simms, General Paul O. Hebert, General Geo. F. Sherman, S. A. Hatch, and General James Longstreet.

In spite of this apparent pot-pourri organization and *modus operandi*, much creditable work, according to the lights and views of the day, was accomplished, some of which, here and there, is still serving a purpose in the advanced ideas and work of to-day.

Of course, there were then, just as now, differences of opinion as to the proper method of treatment to be applied to control the high waters of the Valley, but that which dominated was "dirt," placed in such localities and in such dimensions as exigency demanded, and resources would supply, from which species of thralldom, in spite of the lapse of time, we have not altogether even yet quite escaped.

While no attempt was made, during the early days of these forty-four years, to formulate and follow standard grades and sections, much discussion was often indulged in as to the *immediate grade and section* required, always, of course, keeping well within the mind's eye the scarcity of the wherewithal with which to provide it.

Thus grubbing trees and stumps from the base of the levee was accepted as a refinement that might, under the circumstances, be dispensed with. Specifications, therefore, then called for it only where levees were under five feet in height; in all other cases, trees and stumps should only be cut down level with the surface of the ground.

Side slopes of 2 to 1 and 3 to 1 were regarded as quite generous, the flatter slope on the river side of the embankment. This, however, was more or less a source for much contention, sometimes being prescribed one way, and then the other. Crowns, except in extremely exposed localities, seldom exceeded six feet in width. Some thought a board fence should be placed in the levee, located along its axis, extending from a depth of three feet below the surface of the ground—the bottom of the muck ditch—to within three feet of the top of the levee, and a number of levees were thus provided. Posts, generally 3" x 4", ten feet between centres, with 1" x 6" weather-board planks, in the rough, nailed horizontally thereto—after the manner of weather-boarding a building.

This was designed to diminish seepage and to thwart the gay and festive crayfish in its excursions back and forth in embankments in search of the water-wagon, and breeding and resting places.

It did neither; it just simply split the embankment in two, impaired its efficiency as a whole, and opened up a route for the crayfish to follow.

By the way, only the past year, 1914, in re-modeling a levee on the East Bank of the River, just above New Orleans, one of these fences or walls was exposed. It was still in a good state of preservation, after a lapse of forty years; but was promptly, sacrilegiously and ruthlessly uprooted and cast away by our up-to-date levee builders, just as were the meat boxes, barrels, logs, etc., similar mementoes of the past, also now and then found in our old-time levee embankments, as living monuments to the easy conscience of the wheel-barrow man hastily finishing his task to swell yardage before the engineer got around.

Possibly a little reminiscence, born of the experiences of the past, of one of the younger assistants of those times in connection with the construction of these fences or walls, may serve to here relieve the monotony of this recital.

Rumors had been rife that contractors were not being over-careful in complying with the specifications prescribing the fence; in fact, were, in many instances, omitting it, though never failing to collect payment for it.

So, this young assistant, who shall be nameless in this narrative, was directed to, as quietly and surreptitiously as he might know how, make a round of the levees in which fences had been prescribed, and ascertain and report facts.

Impressed, through his extensive reading of, but limited experience with, the life of the bold and daring, that the generally accepted method of properly and summarily catching culprits unsuspectingly in the act was to swoop down upon them in the night, he just nonchalantly dropped in after dark upon one of these suspected pieces of work. It was a very dark and a very gloomy night, cold and wet, and shelter in the shortest order and of any kind, most acceptable.

This could only be found in the levee camp itself.

Upon entrance, he was promptly recognized and received with open arms; good cheer soon followed, solid and liquid, and the topics of the day freely discussed, but not a word about fences in levees. Nay, nay Pauline! Mr. Assistant was too wise (?) for that. However, a little later on, quite a fit of drowsiness came over him, when he was considerably and attentively shown to bed, and made comfortable for the night.

Sleep? Why he never opened his eyes again until noon the next day. Then followed breakfast and dinner combined, quite elaborately served and consuming much time.

Then a stroll over the work. Everything in apple-pie order, and the most perfect of board fences looming up for some three hundred feet in advance of the embankment. Good, here was *one* contractor who had been maligned, and so he reported.

Well, do you know, this young assistant's Chief was not satisfied, and then and there took upon himself the investigation *in persona propria*?

He wanted to know what about that part of the fence covered over by the earth embankment. Could not say unless the embankment were torn down. Could not understand how anyone could see through such a covering, and the X ray was yet unknown to science.

"I'll show you," said Mr. Chief.

"All right," I'll show you," said Mr. Chief.

Another visit to the locality with Mr. Chief, armed

with a long iron probe and a heavy maul. This probe, with the aid of three men, he drove horizontally into the embankment to the line upon which the fence should be in evidence and stop its further advance.

This process was tried at every fifty feet in the length of the embankment, and never was the bar once arrested in its passage until it struck that three hundred feet which had gladdened the eye of the young assistant.

In about a mile of embankment, this three hundred feet, and only it, of the weather-board fence required had been supplied, and this had been rushed up while His Assistantship was enjoying his entertainment and sleeping off the dope—knock-out drops—administered to him with the refreshments. This is an o'er true story. No one better than your writer knows whereof he speaks.

With the passing of the weather-board fence, meat boxes, barrels, logs, etc., there followed too, in 1892, the abolition of the ancient and time-honored dahl or flume, of every design and form of construction, passing under and through the levees, here and there and elsewhere, almost every mile on the Mississippi River, from Baton Rouge to the Gulf of Mexico, and on Bayou Lafourche, from Donaldsonville to the Gulf.

These, as you probably all know, were used to conduct water from the river to the rice fields for irrigation, each dahl or flume constituting practically a crevasse in fact or in incipency during periods of high water, and, as a matter of fact, being responsible for fully nine-tenths of the crevasses in those days.

By a sweeping Act of the General Assembly of the State in 1892, the siphon took the place of the dahl or flume, carrying the water *over* the levee, to the ultimate approval and satisfaction of all concerned.

But, oh, at first! In spite of the fact that the principle of the siphon was known, and that siphons were operated some 1,500 years before Christ, what a howl went up about this new fangled notion and fad of the Engineers.

Another thought, with particular reference to the "Lower Coast," that while the slope of the levee on the land side might be as steep as 2 to 1, the slope on the river side should not be

steeper than the slope of the sea beach, 7 to 1, built in terraces, in one foot, two feet, three feet rises, distributed in proportion to the height of the levee, each rise to be revetted with horizontal planks, fastened to uprights, driven down through the embankment into the natural surface of the ground—the spaces between each rise being filled in horizontally with earth tamped, and planted with Bermuda grass. A patent was taken out for this, but the plan was never put into practice but once—on the Harlem Levee, in the Parish of Plaquemines.

It failed the very first time the river faced it, the terraces washing out from return waves and undercurrents, leaving the uprights and planks generally standing up like so many washed-out sign boards at a country road-crossing.

This was a time before railroads “a plenty.” Travel was wholly by boat and team.

When river craft and travel were at their heyday, time was at a discount. It was no uncommon experience to wait upon the banks of the river for a day or more for a boat—not that boats were scarce, but because they simply did not happen to be plying in the particular local trade and shipping in question.

Once aboard, however, the traveler was in clover, so to speak.

The traveling was simply luxurious; nothing could have surpassed the elegance and comforts of life to be found upon the Mississippi River Packet or steamboat of that day. They were floating palaces, with the best of service and fare, commanded and piloted by a class within itself, noted for its ability, courage, endurance, and desire to protect, accommodate and please the traveling public.

Really in those days, the Mississippi River Packets were mostly things of beauty, and it is only too sad to think that they should not have remained “joys forever.”

It was a delight to travel on them, and many was the trip delightfully enjoyed by your writer.

So, we won't dwell upon the waits on the banks of the river, but hold in pleasant memory the holidays enjoyed in going from one point to another.

Among these packets, of which there was a veritable fleet, recalling pleasant memories to the writer, may, without effort,

be mentioned the "Wild Wagoner," the "Bart Able," the "Par-gaud," the "Edward J. Gay," the "Katy," the "Richardson," the "Natchez," the "Robert E. Lee," and the "J. M. White," the latter three ever in the field to outrival one another in all that went to make steamboating ideal.

The travel by road and team was not much different from that of the present day, or from what *it* can, in anything like the near future be—trying at best.

However, contrasted, in the matter of time and expediency involved, with the travel by water and road in the early days of the period under consideration, are the miles upon miles of railway systems of the present day, reaching out in every direction, vying the one with the other in speed and comfort, and mocking at time and space, not to mention automobiles, motor boats, etc., etc., permitting service not then dreamed of.

Corresponding with the difficulties attached, during these early days of this period, to rapid transit, may also be recorded the absence, as a general proposition, of accommodation for the general public, in the way of hotels, inns, etc. These were few and far between.

The numerous cities, and towns, and villages that now thrive throughout the State, along all lines of travel and transportation, particularly along the lines of and in the pathway of railroads, were still unthought of, and the ordinary every-day traveler had often to feel his way, mile after mile, and keep mighty wide awake and weary to be sure of a roof over his head for the night, and a bite to quiet the craving of his forced dietetic stomach.

However, here again, the star of the "levee engineer" was ever in the ascendant.

It was only sufficient for him to show that he was identified with the problem and work of protection from overflow to be everywhere received with open arms, alike at the most humble home of the most modest dweller along the banks of the river, and at the palatial mansion of the riparian owner. And right royally were you thus at most times treated.

In between, however, it, at times, happened that any old

upon the unwary Hibernian to trap him into dallying in a camp.

One is very fresh in the memory. The flag of Erin floating over the door of a commissary with a sign below it, upon which in large letters appeared the following:

“Ould Ireland foriver”

“Free.”

“Whisky and Buttermilk”

Paddy would cock his eye upon that sign, and forthwith make a break for the counter, where he was served with a gigger of whisky and a tumbler full of buttermilk, as a chaser, turn on his heel and start to walk out, when he was brought to a sudden standstill by the words—“And what about the Siller, Paddy?” “Siller! and what about that sign over the dure about ‘free whisky and buttermilk?’” “You’re off in larnin Paddy.” Notice the wee fly speck after ‘Free,’ and then what does the sign say?” “Ould Ireland foriver free.” “Whisky and buttermilk.” “Tin cints—fork over,” and Paddy forked over.

Well, you would suppose that such a thin proceeding would soon have an end. But no, Paddy just simply passed the word around to other unsuspecting thirsts about the joy of the new drink, and lay around to see the game played over and over again on one after another.

Since then we have seen the wheelbarrow practically crowded out of business and the advent of the drag-scraper, wheel-scraper, grader, dump cars, narrow-gauge railway and cars, traction engines, power-driven floating and land dredges, and tower and other classes of conveyers, galore.

Along the latter lines much good headway has already been made, but the ideal mover of earth for levee embankments has not yet been produced.

Do not imagine that the reservoirst, outletist, spillwayist, etc., was, in these early days, still unborn; on the contrary, he was there on the job just as in more recent years, and not any more successful, except in wind and on paper, just as his successors also are to-day.

The long-headed engineering advisors of those days paid as little heed to them as those of to-day do.

To the latter, as it is to those of to-day, the practical side of

the proposition was to keep the high waters *off* of the Valley and *in* the river, and but one course to accomplish this presented itself—levees—dirt and then mort dirt. Only then as now, resources were inadequate.

At one time, during this period, the State of Mississippi had a very distinguished engineer in charge of its defenses against high water, Major William Starling, and, while he seemed to be doing everything and pursuing every course just right, it occurred to the Governor of that State that if Major Starling were only given the opportunity to see what had been and was still being done along the same lines, “across the waters,” the problem at home might prove much nearer solution. So, he was commissioned to go to Europe and given *carte blanche* to visit the systems of levees and dikes, etc., over there, and study and report upon the same.

Upon his return, Major Starling published a most interesting account of his investigations, but declared that he had learned nothing new; for, beyond certain refinements in paving the slopes and crowns of embankments and converting the latter into magnificent highways, the systems were not in any material way different from ours, and depended just as ours, on “dirt,” and then “more dirt.”

In the higher grades and greater cross-sections being prescribed to-day, by the Mississippi River Commission, is this principle being undoubtedly further recognized, and the day is not far distant when no other principle *will* be accepted.

It is the finally economic and practical solution of the problem.

There is but one place for the surplus waters of the Mississippi Valley, and that is *in* the river, confined there by its natural banks where high enough, and by levees where otherwise.

Let us with one accord but proclaim, first, last and all the time, for levees and bank protection, and victory will not fail to eventually perch upon our banner.

In 1877 the Board of State Engineers, Louisiana Levee Company, the several Commissions and carpet-baggism described, passed out of existence, and a new order of things instituted,

under Democratic rule, with Governor Francis T. Nicholls at the helm.

A new Board of State Engineers was provided for, similar in number, with B. M. Harrod as Chief, and T. S. Hardee and H. B. Richardson as Assistant State Engineers.

This Board held sway until 1879, when, under Act 33 of the General Assembly of that year, it was reorganized with amplified powers, the personnel, however, remaining the same. Under this Act, the alluvial lands subject to overflow in the State were divided, geographically, into six levee districts, with Boards of Levee Commissioners—one member from each Parish in a district—with powers to levy ad valorem taxes and forced contributions, the proceeds of which were deposited with the State Treasurer, and expended for levee purposes, by the State, through the Governor and the Board of State Engineers.

These Boards of Commissioners were simply producers, levying taxes, etc., within the limits of the law, necessary to cover and carry out the recommendations and estimates of the Board of State Engineers.

Methods becoming thus gradually more systematic and comprehensive, much advance was made, and much good work performed upon decidedly improved economic lines, the average cost of the levee work performed being reduced from fifty-five cents per cubic yard to twenty-five cents per cubic yard.

Recognizing the improvement following this line of organization, the formulation of other levee districts, on still broader lines, authoritative and financial, later on, that is commencing in 1884, followed, until as many as seventeen levee districts are now provided for by law, fifteen of which are in actual and active operation.

With regard to the cost of work performed, little material reduction can be recorded for some years following. There was much to do and comparatively few operators with which to do it. However, within very recent years, many operators were attracted to the field, and, with the introduction of new methods of construction, the cost of levee work was gradually reduced, until within the past five years, the levee work performed under contract awarded to the lowest responsible bidder, has averaged a fraction less than twenty-one cents per cubic yard.

It is but just to here record, too, that even with this gradual reduction in cost, many refinements in specifications were added. The preparation of the base, including the grubbing up by the roots of all trees and stumps, within the prescribed limits, and for five (5) feet beyond, on each side; muck and search ditches, wider berms, restrictions in depth and slopes of *borrow pits*, and, later on, to protect against steamer and wave wash, wooden revetments followed; and to the same end, and to reduce seepage, under and through embankments, reinforced concrete curbs, extending, according to local conditions, various depths below the surface of the ground, with reinforced concrete pavements up and over the river side slope of the levee to the net grade of the latter.

During this part of the evolution, the Board of State Engineers still remained the pivot about which operations, directive and supervisory, rotated, the number of its members being, in 1882, increased to four, and in 1884, to five.

During the period from 1877 to 1914 the Board of State Engineers suffered but little in change of personnel as compared with the Board from 1871 to 1877, and the lapse of time, embracing only five Chief Engineers, B. M. Harrod, T. S. Hardee, B. H. Greene, H. B. Richardson and the writer. One of these, however, B. M. Harrod, soon became a member of the Mississippi River Commission, and served as Chief State Engineer but about three years; another, T. S. Hardee, owing to his death, served but about one year; and one other, B. H. Greene, becoming, shortly after appointment as Chief State Engineer, Chief Engineer of the Texas & Pacific Railway Company—but about three months; the other two H. B. Richardson, resigning to accept appointment upon the Mississippi River Commission, and the writer, therefore, serving about twenty and twelve years, respectively.

H. B. Richardson and the writer, before appointment to the position of Chief State Engineer, had served as Assistant State Engineers.

Of the other Assistant Engineers and Members of the Board of State Engineers, during this time—37 years—serving, were the following:

S. F. Lewis, H. C. Brown, II. Bolivar Thompson, John Smythe, Arsene Perrilliat, Gervais Lombard, H. C. Smith, M. P. Robertson, Walter H. Hoffman, Joseph W. Monget, and John Klorer—the present incumbents being, Gervais Lombard, M. P. Robertson, J. W. Monget and John Klorer.

In 1879, the National Government, becoming finally impressed with the enormous burden and hereulean task with which the people of the Lower Mississippi Valley were struggling, at last sat up and took real notice, resulting in the organization of the Mississippi River Commission, composed of four officers of the Corps of Engineers of the U. S. Army, and three persons from civil life, two of whom should be Civil Engineers.

This Commission was charged with the duty of making an intimate study of the problem of the control of the Lower Mississippi River and formulating plans for its solution, and has so faithfully, elaborately and profoundly performed this duty that victory is clearly in sight, if not at hand.

The construction and maintenance of levees to confine the high waters of the Valley to the main stream was soon recognized and accepted as the main factor to success in the control of the river, and in 1882, after the disastrous overflows of that year, provision was first made by the United States to aid the local levee authorities along those lines.

Thus was the way made clear for inaugurating the systematic study of the problem by the best talent available, with the strong box of the National Government back of it, resulting in the broadening of effort by all in interest.

With this organization, the experience in years gained by the conduct of the river itself, the gradual growth, from year to year, of aid from the National Government, the problem has now been practically shorn of any element of doubt. General Ben. Butler, of Silver Spoon fame, is reputed to have once expressed himself as very partial to widows, because widows knew what they wanted, and how to get it. Like Ben. Butler's widows, the Engineers now know what they want, and *how* to get it. It only remains for the National Government to respond with the necessary contributing appropriations in fixed annual installments to meet their estimates and cover the plans for the Valley

to be able to proclaim, to the Commission, in comparatively few years, "well done, though good and faithful servant."

Before 1871, the question of the grade to which the levees should be built to oppose such high waters as might develop when all the basins were closed and all the levees held, was almost impossible of forecast. In spite of the most scientific deduction, demonstration of the *effect* was imperative. Yet the Engineers of that day, and they were of as fine an order as any of the present day, as any of us would admit if we had but been permitted to follow them in their labors and works, attempted such a prophecy, reference to which, in connection with later-day efforts may not be uninteresting to you.

So we find, in the report of the United States Engineers, A. H. Humphreys and Henry L. Abbott, upon the physics and hydraulics of the Mississippi River, the following for a "perfected levee system," from Cairo down, based upon the conduct of the high water and flood of 1858:

"Near the mouth of the Ohio River, they (the levees) should be made about three feet above the actual high water level of 1858. The height above this level should be gradually increased to about seven feet at Osceola, and thence to Helena. Thence to Island 71, the height should be gradually increased to ten feet; thence to the vicinity of Napoleon, it may be gradually reduced to eight feet; thence to Lake Providence, it must be gradually increased to eleven feet (above the mark of 1858); thence to the mouth of the Yazoo, it may be gradually reduced to six feet, and should be thus maintained to Red River Landing. Between that locality and Baton Rouge, it should be kept uniformly about four feet above, and below Baton Rouge, about three feet."

No further attempt to suggest ultimate grades was made by anyone really competent to do so, until 1898, when the Mississippi River Commission announced an estimated ultimate high water in the Valley, and a provisional grade two feet superior to the latter, ranging, according to locality, from 2.0 feet to 4.5 feet higher than that of Humphreys and Abbott.

So far so good, but the high water of 1912 came along, more nearly subjected than any previous big and prolonged high water to that control imposed by all basins being closed and all

levees holding, and with it experiences demonstrating the necessity for again revising this estimated ultimate high water and provisional grade, resulting in a recent announcement to that effect from the Mississippi River Commission, calling, here and there, for still higher grades, according to locality, as shown in the following:

	2 Ft. above estimated ultimate H. water	3 Ft. above estimated ultimate H. water
Cairo	1898, 56.17 feet—1914, 58.00 feet on gauge,	+1.83 Ft.
Memphis.....	1898, 43.60 feet—1914, 51.50 feet on gauge,	+7.90 Ft.
Helena	1898, 56.10 feet—1914, 58.50 feet on gauge,	+2.40 Ft.
Arkansas City.....	1898, 58.30 feet—1914, 60.50 feet on gauge,	+2.20 Ft.
Greenville.....	1898, 52.50 feet—1914, 55.80 feet on gauge,	+3.30 Ft.
Lake Providence.....	1898, 50.00 feet—1914, 53.70 feet on gauge,	+3.70 Ft.
Vicksburg	1898, 57.05 feet—1914, 58.00 feet on gauge,	+0.95 Ft.
St. Joseph.....	1898, 52.80 feet—1914, 54.00 feet on gauge,	+1.20 Ft.
Natchez.....	1898, 56.00 feet—1914, 57.50 feet on gauge,	+1.50 Ft.
Red River Ldg.....	1898, 54.50 feet—1914, 57.50 feet on gauge,	+3.00 Ft.
Bayou Sara	1898, 47.70 feet—1914, 51.50 feet on gauge,	+3.80 Ft.
Baton Rouge.....	1898, 45.20 feet—1914, 48.10 feet on gauge,	+2.90 Ft.
Plaquemine	1898, 40.70 feet—1914, 43.70 feet on gauge,	+3.00 Ft.
Donaldsonville.....	1898, 36.95 feet—1914, 39.00 feet on gauge,	+2.05 Ft.
College Point.....	1898, 31.80 feet—1914, 34.40 feet on gauge,	+2.60 Ft.
Carrollton	1898, 22.35 feet—1914, 25.20 feet on gauge,	+2.85 Ft.
Fort Jackson.....	1898, 10.00 feet—1914, 11.00 feet on gauge,	+1.00 Ft.

However, lest the foregoing statements of facts tend to give the impression that the raising of grades will thus prove to be a continuous performance in the future, based upon the fallacious argument that the "higher the levees, the higher the waters," it can be unquestionably stated that at none of the regularly established stations on the Mississippi River, from Cairo to the Gulf, did the flood of 1912 reach a height equal to that of the provisional grade line, nor did a crevasse occur in any levee built to the grade and section advanced by the Mississippi River Commission in 1898.

In other words, had the entire line of levee on the Mississippi River in 1912, been built up to the *then* provisional grade and section of the Mississippi River Commission, it would nowhere have been over-topped, and would possibly have escaped serious disaster.

In other words, it was necessary that some water of great

volume and prolonged flow must, with reasonable success, be carried to the sea, between levees, with all or nearly all the upper basins closed, and all the lines of levee constructed, holding, before anything like a final conception of an ultimate high-water plane in the Valley and an ultimate grade for its levees could be definitely advanced.

This condition was more nearly approached in 1912 and 1913 than ever before, and there is every reason to believe that the latest deductions of the Mississippi River Commission are, at least, approximately close to the mark, and the elevation of grades, in the Lower Mississippi Valley, very near, if not at its end.

Just here, if you will forgive so greatly further trespassing upon your time and already over-taxed patience, permit a word or more about the increase in frequency and volume of floods in recent years, and the raising of the bed of the river, so often flippantly and erroneously claimed by the uninformed.

On this subject no higher authority than Col. C. McD. Townsend can be quoted. He says that there is no evidence of any such increase in the frequency and volume of floods, and proves that with such constant mutations as affect the question, the only way to determine whether the river bed is rising or being scoured out, is by comparing corresponding low waters with each other, or corresponding high waters.

"Several hundred years ago, a French traveler visited Italy, and on his return, reported that levees *had* raised the bed of the River Po. His statement was carefully investigated and found to be untrue; but, like Wex's assertion that the cutting of forests has injured river beds, it has traveled over the whole world where rivers have been improved, and vexed the engineer in charge of their improvement."

"The French Engineers have made careful investigations of the leveed rivers of France, and found no evidence of such action."

"The Germans have studied the Rhine and the Austrians the rivers of Austria-Hungary, and failed to detect it. The Mississippi River Commission has made similar observations of the Mississippi River, and found more evidence of scour than of fill.

In no case has it been observed that the effect of levees to raise the bed of the river was more than a few tenths of a foot in a hundred years, and may be termed a 'geological effect resulting from the lengthening of the river as it deposits its silt at its mouth as to anything else.' The assertion is now admitted to be false on the main rivers of all civilized countries which are capable of being studied."

Returning now, as well as we may, from the many side excursions upon which we have been conducted, it may be proper to here dwell to some extent upon some of the later-day phases of the proposition.

In spite of the established fact that a steady advance was ever being gradually made towards combatting conditions in the Valley, it must be admitted that, now and then, reverses of the most serious and disheartening character maintained.

However, each later experience was less severe than the previous. So that, from hundreds of crevasses in 1882, overflowing as much as seventy-five per cent of the alluvial lands of the State, the record in 1913, with a greater volume of water, within a given time, passing Cairo, shows but *one* crevasse in Louisiana affecting only some 3 1-2 per cent of the alluvial lands in the State subject to overflow.

In conclusion, it is, therefore, felt safe to unquestionably claim that with the experience of all these years, and, later, under the diligent and enlightened researches of, and the reports and literature published by the Mississippi River Commission, there can be no doubt but that we should be prepared to at least support the following contentions against the ignorance and folly of the past:

1. That high waters in the Lower Mississippi Valley grow no more frequent and no higher than estimated from the beginning by engineers of repute, when all the basins in the valley be closed, and all the levees hold.

2. That the romances in regard to the elevation of the bottoms of leveed rivers are untrue.

3. That the bottom of the Mississippi River has *not* been raised, and the cross-sectional carrying capacity of the Mississippi River has *not* been impaired, to any appreciable degree, in

one hundred years. On the contrary, its discharge capacity, under normal conditions, has been greatly improved.

4. That the only and proper place for the surplus waters received in the Valley, is *in* the river, between natural banks where high enough, and artificial ones where not so fortunate, and that it only requires bank protection work in concave bends, and embankments properly located and constructed, to proper grades and sections, with due regard for niceties in construction, to control the floods of the Valley.

5. That the levee system in the Valley, generally, and in Louisiana particularly, after many years of trying experiences, is, at this time, nearer a standard of efficiency and requires less to be done to it to insure its efficiency than ever before in the history of the Valley.

It, therefore, seems but just to here claim that it is in the trying experiences of these many long years about which the writer has, in fairly short meter, compared with the lapse of time, tried to cover, that the steady uplifting of the service of and the co-operation between the State and the Nation, has been evolved and these conclusions been rendered practically irrefutable.

And now, with the encouragement assured by the continued good work of the Mississippi River Commission, with the co-operation of local authorities, the Government itself cannot help, sooner or later, but be convinced of these facts, and accept the proposition that the Mississippi River problem, within and by itself, is big enough and momentous enough to be adopted as a project by itself, placed upon a plane with that pride of the Nation, the "Panama Canal," and provided for in the same way as an undertaking for our National Engineers, supplied with all the authority and all the resources necessary to "deliver the goods."

The solution of the problem, by well known and accepted plans, is recognized, the present organization is a well-advanced going proposition, along systematic and comprehensive lines, and all that is needed is the active adequate support of the National Government to reach the goal in comparatively few years. Why then, at this late day, side track this apparent certainty and trifle

with unproven propositions and new issues provocative of years of question and corresponding differences of opinion fraught with dissension and delay—as reflected in the much talked about and widely ventilated vaporizations of certain dreamers about Nation wide constructiveness and co-ordination?

Discussion.

THE PRESIDENT: You have heard the very interesting and instructive paper delivered by Major Kerr. I am sure we all enjoyed it. I will entertain a motion for a rising vote of thanks.

MR. COLEMAN: It gives me great pleasure to offer that motion.

THE PRESIDENT: Everybody in favor will say Aye. Opposed, No. Motion carried.

Now, gentlemen, I will be very glad to have any comments or discussion on the paper. The evening is young yet, and I will be glad to hear from anyone who may care to discuss the paper.

MR. COLEMAN: I would like to ask one question of the Major, and that is, in regard to the prices that were paid in the days of the Louisiana Levee & Construction Company—I would like to know if these payments were in cash—65c and 50c a cubic yard. Were these paid in cash or script?

MAJOR KERR: They certainly made them pay in cash. There was a method about that. They got cash.

MR. ROBERT: There is one thing I would like to ask. The Major spoke of a little anecdote, there were two men occupying a deserted tomb. I would like to know how that tomb got deserted?

MAJOR KERR: The occupants just wore out. [Laughter.]

THE PRESIDENT: I see one of our old levee builders here, Col. Lewis.

MR. LEWIS: As to that portion of the instructive and interesting paper read this evening by Major Kerr, Chief State Engineer, which deals with events and experiences in levee construction in this State previous to the year 1877, I am only familiar with through hearsay. The intervening years between 1871 and 1877, constituted six out of ten years of what is known in the History of Louisiana as the "Reconstruction Period," a

decade of disgraceful infamy in the administration of the public affairs of this State, the natural sequence and following in the wake of the defeated Southern States of this Great Republic in the Civil War. I was at the University of Virginia from 1870 to 1874, and after receiving my degree of Civil Engineer, I returned, practiced my chosen profession under difficulties during these trying times, never dreaming or expecting to have anything to do with the levees of the Mississippi River and its tributaries in this State, or problems affecting its treatment. In 1877, when Francis T. Nicholls became Governor of this State, and Democracy triumphed and the State was relegated to its own people, the Board of State Engineers was reorganized, and through the Governor's instrumentality I became an employee of that Department. It was then that I became acquainted with the writer of this paper, who like myself was one of the three employees in this Department. I was Assistant State Engineer from 1880 to 1908, and severed my connection in September, 1908, with the Board of State Engineers to be elected Chief Engineer of the Board of Levee Commissioners of the Orleans Levee District, which position I now occupy. From 1877 to 1915, over thirty-eight years of my life has been devoted to the study of the Mississippi and adjacent streams in Louisiana. I can substantiate, all that is related in this paper of my confrere, for I have gone through the same experience. As to the construction of levees, like similar engineering enterprises, it has had its history of evolution,—from the sole use of the wheelbarrow to the use of different kinds of scraper and wagons, to that of handling earth by mechanical devices. The first levee built with wheel scrapers in this State was at Airlie, East Carroll Parish, La., in 1881-82, when I was a member of the Board of State Engineers, and assisted in the location of this levee. The application of machinery to the construction of levees in this State was first undertaken in 1893 by the Atchafalaya Basin Levee Board, on the west bank of Bayou Lafourche, under the supervision and direction of the eminent engineer Arsene Perilliat, who was then a member of the Board of State Engineers.

As to the relative value of levees built with wheelbarrows, scrapers or machinery as used to date, there is a difference of

opinion among levee Engineers. Wheelbarrow work is slow, scraper work will do for levees of certain dimensions, and machinery built levees have cheapened very much the cost of work. In my judgment, the wheelbarrow and scraper are not as yet to be superseded in toto by the present methods of construction of levees with machinery, for this reason, viz—that the wheelbarrow and the scraper will build the embankment to the necessary height in layers as it should be, distributing the material uniformly from base to base. To do this by the present mechanical devices in many cases is simply impracticable, and in consequence in levees built by machinery, there is less homogeneity in the particles of earth, composing the mass of the embankment, the shrinkage is equally as great as wheelbarrow work, the rain wash is equally as great as scraper work, more so than in wheelbarrow work, but above all is the unequal distribution of material, a danger of overloading the crust of solid earth that has to sustain the weight of the material, and the result of a rupture of foundation, and then trouble galore. Such as is apparent to-day from machine built levees at Caernarvon in the Parish of Plaquemines on the east bank of the river about 12 or 13 miles below the city, and at Couret on the west bank, seven miles below Algiers Ferry in the Parish of Orleans, the latter of which your humble servant is the Engineer and Doctor. I do not mean to infer that it should be prohibitive to build levees by the present mechanical devices, but I do say from my experience, that the right kind of a machine to build a levee, and comply with the specifications required in the construction of an embankment to retain the floods of the Mississippi River has not yet been devised. I believe however, in the near future that a levee building machine will be evolved, that will comply with all the requisites in handling earth and distributing same in uniform layers as required in an embankment, that serves the purpose of prevention from overflow.

During the construction of levees, it is absolutely necessary that some responsible party should be Inspector, and his foremost duties are prescribed to see that the base, cross-ditches, etc., are thoroughly plowed and cleaned or cleared of foreign material, that search ditches if required be dug of certain dimensions in

line with the embankment so as to discover if there exist hidden pipes, foundations or other obstructions that should be removed from the base of the levee before the earth is placed in the embankment. This, by far, is a most important and responsible duty required during the construction of a levee, and the position is generally filled by the most incompetent and irresponsible agent. There has been very little improvement in our methods of inspection during the evolution of the Levee System, and in consequence the same accidents that took place in former days, due to careless and indifferent inspection, occur from the same cause to-day. These responsible positions of Inspector are generally appointments paid by the Levee Board in which District the work is being done, and are filled by laymen, who outside of the salary attached take very little interest in the matter, and do very little inspection.

I have had to go through a recent experience from the carelessness of an Inspector appointed by the Levee Board of which I am the Chief Engineer. The Board of Levee Commissioners of the Orleans Levee District recently built under contract a wheel scraper levee 3,900 feet in length, contents 154,980 cubic yards on the west bank of the river, some six or seven miles below Canal St. Ferry Landing in front of what is known as the Orleans Plantation. The contract was awarded July 9, 1914, to be completed January 15, 1915. It was completed on October 29, 1914, and the contractor received \$2,500 as an additional compensation. It was received and accepted and the Chief Engineer commented and praised the contractor for the excellence of his work. It was built by the Contractor's outfit and that of three sub-contractors, and there was an average of 75 wheel scrapers daily on the work. There was an Inspector employed at the rate of \$100 per month, whose duties were prescribed by the Chief Engineer as to the specifications with regard to preparation of base, cleaning out cross-ditches, digging a search ditch through the center of prescribed dimensions, viz, 4 ft. wide on top, 3 feet deep and 2 feet wide at the bottom, the keeping of a daily record, and forwarding same weekly to the office of the Chief Engineer. All of which was apparently complied with.

About six o'clock in the morning of the 16th of February a

suspicious hole developed about six feet on the land slope of this levee in front of the residence and quarters of the Orleans Plantation, through which flowed river water, thus showing direct connection with the river. I received a telephone message at 8 a. m. that there was a serious leak through the base of this levee. I found on examination that the leak came from an abandoned two-inch water pipe formerly used to water stock on the plantation, which had not been removed by the Contractor, and over which the embankment had been built. It was absolutely necessary to stop the flow through this pipe, and to secure the levee. With a head of six feet of water against this levee, I located with considerable trouble the intake of this pipe, I found the intake to be 130 feet below the discharge end, the pipe lying diagonally across and through the levee, and furthermore, about six inches below the natural surface of the land, conclusive evidence that the base had not been ploughed or the search ditch dug by the subcontractor who built this section of the levee. It has cost the Orleans Levee Board \$624.00 to locate, arrest the flow through this pipe, and secure the levee, and when the river recedes below its banks, the levee will have to be cut, and the pipe removed which will entail an additional expense, all due to careless and negligent inspection.

Again on Saturday the 6th instant, I received a message about 11 a. m. that there was a leak in a pipe on North Peters Street, between Elysian Fields and Marigny Streets, Third District. After excavating some five feet below the surface of the street, we found the leak to be through the broken flange of a 12 inch abandoned supply pipe to the New Orleans Railways and Light Co. Power Plant, corner of Elysian Fields and North Peters Streets. No record in the office of the Orleans Levee Board with regard to the location of this pipe could be found, in fact there are some two hundred pipes of all sizes piercing our levees on the commercial front of this city, many of them I presume long abandoned, where there is no record of location. In order to plug this 12-inch pipe, we had to locate the intake at the river end; then dig through the crown of the levee, an area 12 feet wide, 14 feet deep and 20 feet long, sheet pile and roughly brace same, remove a section of the pipe, and plug same at both

ends. I don't know where the next trouble is going to be, but when I am aroused from my lethargy by these sudden calls during periods of high river, I feel like quoting poetry, and if I were not bald-headed, I could say like the Prisoner of Chillon:

“My hair is gray, but not with years
Nor grew it white in a single night
As men's have done from sudden fears.”

THE PRESIDENT: Where is this pipe?

MR. COLEMAN: It is located on North Peters Street between Elysian Fields and Marigny Streets.

MR. LEWIS: Yes, sir, and I presume the New Orleans Railways & Light Co. will pay for the expense incurred in stopping the flow of river water through this pipe, as well as securing the levee at this point. Now, as to the responsibility of my position, I don't know why I was elected Chief Engineer of the Orleans Levee Board, unless it be from the fact that I previously served as State Engineer for twenty-eight years without very much responsibility attached to the position. During one of these high water periods we are going to experience serious trouble from these pipes that permeate our levees. It is bad enough to have abandoned and unknown pipes to bring on accidents, but when a pipe is left in the base of a new levee under construction through carelessness and imperfect inspection it reflects very much on the efficiency of the levee system. There is evidently something wrong about the employment of Inspectors, and I believe this can be rectified by the members of the Louisiana Engineering Society. We have young men here in this city and State, who are receiving yearly, diplomas in engineering from the Louisiana State and Tulane Universities, and other institutions of Technology, who can best fill these positions and for less salary than is usually paid to a lot of incompetent, and not trustworthy men, employed on our public works, simply because the men who control these public boards, place them there for selfish or political purposes.

MR. HOFFMAN: I am not a speech-maker, but I wanted to ask Mr. Kerr if it is not a fact on the Red River, that the confinement of the river by the levees has deepened the river bed?

MAJOR KERR: There never has been a more striking evi-

dence of the enlargement of a system by confinement than upon Red River, particularly that part of Red River in the Bossier Levee District and Caddo Levee District; that is, extending along the fronts of the Caddo and Bossier Levee Districts. When I was first detailed to that section, to look over the possibilities of protection from overflow, why Red River, from the State line down to thirty-five or forty miles below Shreveport, was a very small stream. It did not average four hundred feet wide, with possibly five or six feet of water in its channel, and the banks not more than ten or twelve feet above the low water line. Now, to-day, since the rafts have been removed by the Government, and the levees have been built by the Levee Districts and the State, it is able to carry its burden between levees; why, that river will now average fully eight hundred feet wide, and it has the same depth of water at low water, with banks from twenty-five to thirty-five feet above the low water line, showing that the bed has been greatly lowered, and the low water line has followed it. There has been no more striking evidence of the effectiveness of the confinement of a stream in the way of enlargement, deepening, and widening, than on Red River, due to the application of levees.

One thing about Mr. Lewis' statement—I don't know whether others were impressed with its possible meaning as I was, or I heard amiss—that is, in regard to the instance that he mentions over the river, and on this side. I don't think it is any argument against the levees, nor do I think Mr. Lewis really meant it that way; it is simply an argument against the system, not the levees. You can have any form of construction recommended vitiated by bad work. You can have the most magnificent fire-proof buildings destroyed by the disregard of some specification, the most magnificent big structures now and then fail, because of the very loose observance of the specifications of the work, and, in the category of mishaps, it is not the levee system that's at fault, but the lack of safeguards in the execution of the work by which it may at times be surrounded. I think that's what Mr. Lewis really had in mind, and meant to express.

MR. LEWIS: I am not making any mention of criticism regarding the actual construction of levees, when I was State En-

gineer and previous to the creation of constituted Levee Boards, the faulty inspection of levee construction resulted in many crevasses, and it will keep on doing so until the present system of inspection is more perfected. I believe that the whole construction of levees should be in the hands of engineers, and not paid inspectors employed by these Levee Boards without any responsibility whatsoever. An Engineering Society, composed as this is of eminent men in the profession, can better the present conditions of employment of engineers on all public works, and force the separate Departments to recognize that these positions should be filled by Engineers rather than by laymen. Some of the most disastrous crevasses in this State have occurred from negligence on the part of Inspectors. Davis crevasse in 1884 on the west bank of the river was caused by a road cut through the levee, which was partly refilled with cinders, and washed out by the paddlewheels of a passing steamboat.

Ames crevasse on the same bank in 1892 was due to the blowing out of a 12 inch pipe, placed in the levee for irrigation of rice fields, and Nita crevasse in 1890 in St. James Parish, East Bank of the river, was due to the blowing out of a rice flume or box, insecurely placed in a levee of recent construction.

MR. GREGORY: In his interesting paper, Major Kerr mentions spillways, I think, only once. Many of us I am sure, would be glad if he would give us further information in regard to spillways. Occasionally we read about them in the paper. I am sure we would like to know more about them.

MAJOR KERR: I would be very glad, but it seems to me that I have been occupying the center of the stage rather too much to-night. That's a big proposition that Professor Gregory has put to me, and I don't feel that I am able to give, on the spur of the moment, any very valuable information about it—personally, I don't believe in spillways for reducing flood levels, in any way, shape or form, on the Mississippi River,—I mean in a sediment-bearing stream like the Mississippi River. I simply don't believe in the treatment. I don't believe that anybody who really has had half the experience that I have had with such streams would advocate the spillway in the connection to which reference is made. Spillways are simply crevasses in a modified or dis-

guised form, and we know, that crevasses, in any way, shape, manner or form, mean retardation in the flow of the current in the main stream, which, in a sediment-bearing stream, means loss of suspended matter and the gradual silting up, not only of the main stream below, but of the spillway or crevasse as well. I myself would be loathe to see anything of that kind introduced along the lower Mississippi Valley. It might possibly work higher up in localities with which I am not familiar, but the question is before the Mississippi River Commission now, for a very intimate and exhaustive study, and it has already largely expressed itself in regard to it. In fact, there is a pamphlet out over Colonel Townsend's signature, which deals rather fully with the question, pretty much along the lines in which I have expressed myself. The Colonel and I are not, I regret to say, for my part, of the same school. He went to West Point and I to L. S. U., but I agree with him fully upon his views of the question, and I don't see where the relief is going to come, through the spillway, to the Lower Mississippi Valley, and that's what is proposed by the spillway—to relieve the Lower Mississippi River of a certain amount of its high water elevation. I don't say that we cannot, for the time being, temporarily, for a given period, do so, by putting in a big enough spillway, but the ultimate effect will be, I am sure, negative. I feel, in fact, very certain that it will be very harmful.

For instance, there has been a spillway spoken of for Bonnet Carré Bend, and near the site of the Lake oBrigne Canal. Now, any spillway at either of these localities, to relieve New Orleans of any material flood elevation, will have to be about four or five miles wide. It would have to be leveed from the river to the lake, and every avenue of travel and traffic would have to be disrupted or inconvenienced or remodeled for the time being; besides which, Lake Ponchartrain, at some time or other, might become so overcharged from this spillway, as to require additional levees to protect the City of New Orleans from back water—possibly the leveeing of Lake Ponchartrain itself. So, there are one thousand and one questions that can arise. I really only referred to that subject in my "story" in a kind of jocular way. However, I will try at some time to go into the thing more

specifically than I have attempted to do to-night. I would also like very much to have the ideas of Mr. Gregory on the subject.

MR. GREGORY: It seems to me that the paper will be more complete with the statement that Major Kerr has made. We know, of course, that slowing down velocity is the cause of depositing silt or sand or whatever the stream is carrying. The ability to carry material varies as the sixth power of the velocity, which means that if the velocity is doubled its carrying capacity will be increased 64 times, and therefore it can carry 64 times as much material as it could at the lower velocity. It seems to me that Major Keer has stated exactly the attitude of the engineers who have paid most attention to this proposition on spillways. The subject is a great favorite with certain laymen that are encountered around the time of high water.

MAJOR KERR: I started to tell you this. But this is simply a "story" presented by me, to-night. That's all I meant it to be. But I hope that I have made myself somewhat more clear about the question of spillways than therein stated. I couldn't do so without a little bit more preparation than now possible.

MR. LEWIS: Concerning the action of Spillways, I can say from my own observation that we have had crevasses or spillways in this State. The Nita crevasse in St. James Parish, east bank of the river, occurred in 1890. It was the largest crevasse in the lower river; and while it discharged some 402,556 cubic feet per second, about one-third of the total discharge of the river at Carrollton for that year, the river gauge at Plaquemine City some forty miles above was not affected, and the gauge at Carrollton was very little affected. The Bonnet Carré crevasse ran from 1874 to 1882. In its incipency it discharged probably as much as the Nita, but before it was finally closed, its discharge was probably about one-fourth, due to the silting of its outlets. The effect on Lake Ponchartrain was to raise its surface about five feet over its normal level. It ruined the oyster fisheries and the fishing and bathing on the Mississippi Sound as far as Ocean Springs, Miss.

If it be proposed or conceived that we should resort to spillways to relieve the river of extreme flood heights, it will take more than one to do the business, at least three if not four, and

the question arises where and on what side of the river will they be located; they will also have to be leveed. The public seems to have forgotten the years when the waters from the Bonnet Carré crevasse from 1874 to 1882, spilled over their belongings until it was closed. With a similar spillway or several spillways on the west bank of the river, what would become of the many reclamation projects under way as well as the Hero Project of the drainage of some 38,000 acres of wet lands on the west side of the river in this immediate vicinity? It is my candid opinion, from my experience and study of the river, that there is but one solution to the problem of controlling the floods of the Mississippi River, and that is by substantial and well constructed levees; and in order to maintain these levees on the caving bends, the bends must be revetted and both erosion and accretion arrested. When this has been accomplished, the extraordinary flood levels of the river will be reduced. We will have periods of high water no doubt, like we had before levees were built, but the floods will be carried safely to the Gulf of Mexico, and crevasses and spillways will be a dream of the past.

MR. COLEMAN: I think the best illustration and evidence of what a spillway would do for the Lower Mississippi River is given to us by the records at Red River landing. The Red-Atchafalaya River consists of a separate system from that of the Mississippi River, and is connected with the Mississippi River by a sort of Siamese-twin connection which, under certain conditions, flows in the Mississippi River, and under certain other conditions, is a spillway or outlet from the Mississippi River. My personal acquaintance with the situation at that point dates from about 1888 or 1889, and prior to that, I am familiar with the records of the United States Engineers showing the relative sizes of the streams that were involved at that point. The Mississippi River at Red River Landing, which is about a mile below this spillway or outlet, in 1845 or 1850, was said to be, and the records of the United States Engineers' office show it to have been, something like sixty-five or seventy feet deep at low water. The Atchafalaya River, which is at the west end of this Siamese-twin connection, so to speak, at that time was about eight hundred feet wide, and something like thirty feet deep at low water.

In 1890, when I was taking a series of observations on these streams, the Mississippi River had reduced in depth to about thirty feet, maintaining the same width between banks of three thousand feet, and the Atchafalaya River had widened to about twelve hundred feet, and deepened to about one hundred feet at low water. I am reliably informed that now, at low water, the Mississippi River is about eight feet deep at that point, and the Atchafalaya River has continued to widen, and to deepen. So it seems to me that we have most conclusive evidence of what an outlet or spillway would do to the main streams. The checking of velocity in the main stream causes a very rapid deposit of the material carried in suspense by that stream, and it seems that the reduction in the carrying capacity of the main stream is almost in direct proportion to the increase in the carrying capacity of the outlet or of the spillway.

I am satisfied in my judgment, therefore, that any spillway which might be introduced into the levee systems of the Lower Mississippi River would, within the course of a comparatively brief period of time, cause a constriction of the Mississippi River, to the extent that the flow through the spillway would account for, in other words, that the aggregate discharge capacity of the main river plus that of the spillway, in the course of a very brief period of time, would be no greater than the carrying capacity of the main stream before the introduction of the spillway.

THE PRESIDENT: We have with us to-night, one of the young State Board Engineers, Mr. Klorer.

MR. KLORER: I had hoped that I would be overlooked in this, but since the discussion seems to have branched along the line of spillways, it occurs to me that it might be of interest to prove the converse of the proposition as proven by Mr. Coleman, namely, that since the operation of a spillway at Red River Landing has resulted in the deterioration of the channel just below Red River Landing, then the closure of a spillway should result in the improvement of the channel.

For this purpose let us consider the closure of some regulated waterway that might well be classed as a modified spillway.

Bayou Lafourche, for instance, was such a waterway. You

will remember it was closed by a dam at Donaldsonville in the early part of 1904. Bayou Lafourche in high water discharged something like 35,000 to 40,000 cubic feet per second. While this amount is small when compared with the discharge of the Mississippi river, at the same time you will agree that it may well be considered as a laboratory experiment on the Mississippi river from which certain deductions may be obtained.

We find by comparing gauge readings from Baton Rouge to College Point, that a certain gauge reading at Baton Rouge, say 36 feet, gave a set of relative readings on the Plaquemine, Donaldsonville and College Point gauges, before the closure of Bayou Lafourche. Now, if there is anything in the theory of relief afforded by spillways, then the closure of an outlet or spillway of the dimensions of Bayou Lafourche should be reflected by increased heights on the Donaldsonville and College Point gauges. But, as a matter of fact, we find the very opposite result to be the case since Bayou Lafourche has been closed; and now 36 feet on the Baton Rouge gauge, while giving the same relative reading at Plaquemine, gives readings 6 to 8 tenths lower at Donaldsonville and College Point. This paradoxical result can be explained only by the acceptance of the fact that the channel of the Mississippi river has been improved by the closure of the outlet or spillway, Bayou Lafourche, and has increased its carrying capacity, as evidenced by the lower gauge readings at Donaldsonville and College Point.

MR. SHAW: As a further demonstration of the points brought out by Mr. Klorer, we might mention the laboratory experiments carried on automatically by the Bayou Lafourche at the time that it served as a high water outlet for the Mississippi. During the maximum floods, the levees of this outlet frequently failed and it did not require a technically trained man to observe or to interpret the effects of such breaks on the navigation channel of the bayou. Members of the dredge crew which was engaged in maintaining a navigable depth in the bayou have told me that following a series of crevasses, they were engaged for months in dredging out the bars that formed in the channel immediately below each break. This same phenomenon is bound to occur in case of a crevasse or an artificial

spillway in the main river. It may not result in a bar of sufficient height to obstruct navigation, but would certainly reduce the cross-section of the channel and thus reduce the carrying capacity of the river. From the "Chain of Rocks" above Cairo to the Gulf, the river has reached its base level and as is the case with all such streams, it maintains a delicate balance of its ability as a geological agent. This ability to affect its basin by scour and deposit is affected principally by the following elements: slope, volume of water and the cross-section of the channel. If any one of these elements is changed, the river will promptly adapt itself to the changed conditions. Mr. William Starling called attention to this fact in his articles on the "Floods of the Mississippi River," which were printed in the *Engineering News* in 1896 and 1897. Major Starling states that while the cut-offs that occurred in the river between Cairo and New Orleans since the first survey of 1821 would total 160 miles, the scouring of the bends following each cut-off has kept the total length of the river in the alluvial valley practically the same as it was seventy-five years before his papers were written.

MR. LAWES: I just want to add to what Mr. Coleman has said about the Atchafalaya river; that notwithstanding the increase of the discharge in that stream, there has been no lowering of the flood levels during high water from that effect. The gauge readings at Red River Landing and below have shown the same relative increase in elevation, that they have at other points. The readings have not been decreased during the flood stages by the discharge through the Atchafalaya river, which, to my mind, means that this outlet does not in any way lower the flood level in the river.

THE PRESIDENT: I will be glad to hear from anyone else on this proposition.

MR. GILLIAN: I would like to ask Major Kerr, while I have this opportunity, what he thinks of the difference in the constructive methods of building levees, now, and in the early days. I mean, comparing the levee built with a team scraper, and a levee built with a machine with a three-yard bucket. For instance, is one as strong as the other, and is there a limit reached

with the machine? How big can the buckets go before we can do away with the scoop?

MAJOR KERR: I regard this question of handing earth for levee purposes as resolving itself, as nearly as possible, into one assuring the ideal way of placing it in position. I may be old-fashioned, but I think the ideal way of placing earth in position to serve this purpose is in strata or layers of certain thickness—three or four feet in thickness—as horizontally as practicable; but I don't mean that where conditions locally demand it, you should not resort to other forms of putting material in. I believe that buckets, handled by machinery, should conform in the spirit with the specifications prescribed for other methods. I think that there are limits to which the man handling material with machinery should be restricted, just as with others. We find generally that quite a percentage of those handling earth with machinery have but one idea in mind, and that is to handle it at the least possible expense to the handler. It does not appear to be altogether so much so with other ways of handling earth, but the former seems to have the idea that he is concerned solely with the factor of expense, and, therefore, generally handles the earth in any old way that anyone will permit. Now, if he is not permitted to put it in that way, but in accordance with the spirit of the general specifications, which require that it shall be put in in strata of certain thicknesses, and as nearly horizontally as practicable, I don't see any difference as to whether machinery, or scrapers, or wheelbarrows are used. As to the question of the size—the size of the bucket—any that could be practically handled is possible of use. The bigger the better. It would cause that much less subdivision of the embankment. It would mean that you would get that much more material in place in a given time, and I think that the use of buckets and machinery is a much more effective way of handling material, rapidly and in bulk, than anything else, and that the time has come when we must resort to that method of constructing our levees entirely. We cannot depend upon the wheelbarrows nor wheel-scrapers nor drag-scrapers much longer, for the enormous amount of earthwork which we have to do, and the finally economic way of putting material in place for levees,

and in accordance with the plans and specifications of the engineers, is going to be by machinery. I don't know whether I have answered your question.

MR. GILLIAN: You think a ten-yard bucket would be as good as a three-yard bucket?

MAJOR KERR: I certainly do think you can so handle it most economically. I would like to see a whole section carried by a bucket at *one* time, if such a thing were practicable.

THE PRESIDENT: If there is no more discussion, we will have something to satisfy the inner man outside, and we will close this discussion, and I will announce that the next paper will be one by Mr. Wm. VonPhul, entitled "A Discussion of the Economic Development of the New Orleans Cotton Warehouses, and a Report of the Preliminary Design of the Plants."

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Annual Report of the Board of Direction, January 9, 1915.

To the Louisiana Engineering Society:

Gentlemen—Your Board of Direction begs to report that during the past year it has held 10 regular meetings and 7 special meetings for the transaction of the Society's business.

The combined reports of the Treasurer and Secretary are submitted herewith.

Attention is called to the number and grade of technical papers presented during the year, and the excellent work of the committee in charge.

The Employment Committee has done the usual excellent work in securing employment, and this committee is deserving of the generous thanks of the Society.

During the year our Society moved its Library and meeting room to the State Museum Building. This move saves the Society \$40.00 per month in rent, which is credited every month to the Library Account. This totals \$480.00 per annum.

In conclusion, the Board wishes to thank the Society for the co-operation of its members, and for the privilege of serving them.

Respectfully submitted,

W. H. WILLIAMS, President.

W. T. HOGG, Secretary.

Annual Report of the Secretary, January 9, 1915.

To the Board of Direction, Louisiana Engineering Society:

Gentlemen—As Secretary of the Society, I beg to submit the following report for the year 1914:

During the year the Board of Direction has held 10 regular meetings and 7 special meetings, with an average attendance of 6.9. The Society held 10 regular meetings and 1 special meeting, with an average attendance of 32.4, the largest being 40, and the smallest 23.

During the year, the membership changed as follows:

Grade.	On Roll Jan. 10, 1914.	Elected.	Reinstated.	Transferred to	Transferred from	Dropped.	Resigned.	Died.	Failed to Qualify.	On Present Roll.
Resident	97	6	0	3	3	1	5	0	2	95
Non-Resident	48	4	0	5	2	1	4	1	0	49
Associate	7	4	0	0	0	1	1	0	0	9
Non-Res. Ass.....	1	0	0	0	0	0	0	0	0	1
Junior	17	2	1	1	1	0	3	0	0	17
Non-Res. Junior.....	5	0	0	1	0	0	1	0	0	5
Student	27	4	2	0	4	0	5	0	0	24
	202	20	3	10	10	3	19	1	2	200

Submitted separately is the Treasurer's report showing his receipts for the year, including last year's balance, to be \$2,057.76, and expenditures, \$2,053.16, leaving the Treasurer's available balance at the beginning of the new year at \$4.60. To this must be added the Secretary's balance, amounting to \$256.75, making the total cash on hand January 9, 1915, \$261.35.

During the month of June of the past year, the Society moved the headquarters of its Library and meeting room from the suite in the City Bank & Trust Co. Building to the State Museum Building. This move saves the Society \$40.00 per month in rent, and it was voted that this saving be given over to the Library account. An account was opened for the Library on the ledger and the Library Committee pays all expenditures for the Library out of this fund. Some of these expenditures, among them the cost of binding magazines, was formerly paid out of the general fund of the Society.

(NOTE.—That portion of the Secretary's report dealing with the financial standing of the Society is omitted here, but will be published in a later issue.)

The following technical exercises were held during the year:

Feb. 9, 1914. Some Applications to Kutter's Formula for Low Velocities and Small Slopes, by Prof. W. B. Gregory.

Mar. 9, 1914. Timber Conservation and Preservation in the United States, by Mr. E. L. Powell.

April 20, 1914. The Resources of Louisiana, by Mr. W. L. Alexander.

114 *Proceedings of the Louisiana Engineering Society*

May 11, 1914. An Illustrated Lecture on Bridge Engineering, by Prof. Donald Derickson.

June 8, 1914. A Discussion on the Preparation of Engineering Estimates, and the Writing of Specifications, lead by Mr. A. M. Shaw.

Sept. 14, 1914. An Economic Concrete Sheet Pile Retaining Wall, by Mr. E. H. Coleman.

Oct. 12, 1914. Freight Handling in River Traffic, by Mr. H. L. Hutson.

Nov. 9, 1914. Contractors' Organization and Equipment, by Mr. Hampton Reynolds.

Dec. 21, 1914. Western River Steamboats, by Mr. R. C. Wilson.

It is with deep regret that we must record here the loss by death of our friend and fellow-member, Mr. J. C. Henry of Natchitoches.

As Librarian of your Society, your Secretary desires to express his appreciation of the efforts of the Library Committee during the past year.

Your Secretary desires to thank the officers and members of the Society for their kind co-operation during the past year. It has been a pleasure to serve you, and I thank you.

Respectfully submitted,

W. T. HOGG, Secretary.

Annual Report of the Treasurer, Jan. 9, 1915.

To the President, Louisiana Engineering Society,
New Orleans, La.

Sir—Following please find the report of the Treasurer of the Louisiana Engineering Society for the period January 10, 1914, to January 9, 1915:

Balance on hand January 10, 1914.....\$ 4.51
Received from Financial Secretary—

Feb. 10, 1914.....\$141.00

Feb. 10, 1914..... 97.25

March 4, 1914..... 190.75

April 7, 1914..... 284.25

May 4, 1914..... 325.00

June 17, 1914..... 152.00

July 11, 1914..... 149.50

Aug. 29, 1914..... 132.50

Oct. 6, 1914..... 98.75

Oct. 28, 1914..... 173.75

Nov. 23, 1914..... 94.50

Dec. 22, 1914..... 214.00

————— 2,053.25

\$2,057.76

Checks issued during this period:

1	Feb. 9, 1914.	City Bank & Trust Co.....	\$ 40.00
2	Feb. 9, 1914.	James M. Robert.....	24.30
3	Feb. 9, 1914.	Combination Tl. Stand Co.....	1.00
4	Feb. 9, 1914.	Searcy & Pfaff.....	54.00
5	Feb. 9, 1914.	F. M. Norman.....	13.80
6	Feb. 9, 1914.	Rogers & Manson Co.....	4.00
7	Feb. 9, 1914.	Manufacturers Record.....	8.00
8	Feb. 9, 1914.	N. O. Ry. & Light Co.....	1.00
9	Feb. 9, 1914.	Tulane Press.....	77.60
10	Feb. 11, 1914.	Fabacher's Restaurant.....	10.60
11	Mar. 3, 1914.	F. M. Norman.....	2.73
12	Mar. 3, 1914.	Wm. Frantz & Co.....	13.29
13	Mar. 3, 1914.	Comb. Toilet Stand Co.....	1.00
14	Mar. 3, 1914.	Engineering Magazine Co.....	3.00
15	Mar. 3, 1914.	N. O. Ry. & Light Co.....	1.00
16	Mar. 3, 1914.	Railway Age Gazette.....	5.00
17	Mar. 3, 1914.	James M. Robert.....	24.70
18	Mar. 3, 1914.	City Bank & Trust Co.....	40.00
19	Mar. 3, 1914.	Cumberland Tel. & Tel. Co.....	13.50
20	Mar. 3, 1914.	Tulane Press.....	37.65
21	Mar. 3, 1914.	Engineering Magazine Co.....	2.00
22	Apr. 6, 1914.	City Bank & Trust Co.....	40.00
23	Apr. 6, 1914.	James M. Robert.....	20.40
24	Apr. 6, 1914.	H. Kokosky.....	14.25
25	Apr. 6, 1914.	Crescent City Film Exchange.....	13.50
26	Apr. 6, 1914.	American Architect.....	8.00
27	Apr. 6, 1914.	Power	2.00
28	Apr. 6, 1914.	Comb. Toilet Stand Co.....	2.00
29	Apr. 6, 1914.	John Riess.....	232.85
30	Apr. 20, 1914.	City Bank & Trust Co.....	40.00
31	Apr. 20, 1914.	James M. Robert.....	20.00
32	Apr. 20, 1914.	Edna Dickerson.....	30.00
33	Apr. 20, 1914.	Library Bureau.....	2.30
34	Apr. 20, 1914.	C. B. Jennings.....	10.04
35	Apr. 20, 1914.	N. O. Ry. & Light Co.....	1.00
36	Apr. 20, 1914.	Tulane Press.....	12.75
37	May 30, 1914.	James M. Robert.....	23.93
38	May 30, 1914.	City Bank & Trust Co.....	40.00
39	May 30, 1914.	Stone & Webster.....	1.00
40	May 30, 1914.	C. B. Jennings.....	11.34
41	May 30, 1914.	Comb. Toilet Stand Co.....	1.00
42	May 30, 1914.	F. M. Norman.....	9.30
43	May 30, 1914.	Electric Ry. Journal.....	2.50
44	May 30, 1914.	N. O. Ry. & Light Co.....	2.00

116 *Proceedings of the Louisiana Engineering Society*

45	May 30, 1914.	Tulane Press.....	9.60
46	June 30, 1914.	W. T. Hogg.....	21.50
47	June 30, 1914.	City Bank & Trust Co.....	40.00
48	July 13, 1914.	Louis Caston.....	30.00
49	July 13, 1914.	Tulane Press.....	49.75
50	July 13, 1914.	Comb. Toilet Stand Co.....	2.00
51	July 13, 1914.	Palfrey, Rodd & Pursell.....	1.50
52	July 13, 1914.	City Bank & Trust Co.....	40.00
53	July 13, 1914.	Cumberland Tel. & Tel. Co.....	11.65
54	July 13, 1914.	W. T. Hogg.....	27.27
55	Aug. 24, 1914.	City Bank & Trust Co.....	40.00
56	Aug. 24, 1914.	Commercial Elec. Co.....	34.00
57	Aug. 24, 1914.	Assn. Engineering Societies.....	100.00
58	Aug. 24, 1914.	W. T. Hogg.....	23.50
59	Aug. 24, 1914.	Tulane Press.....	29.75
60	Oct. 1, 1914.	A. C. Bell.....	60.00
61	Oct. 1, 1914.	Wm. Frantz & Co.....	12.45
62	Oct. 1, 1914.	Searcy & Pfaff.....	37.00
63	Oct. 1, 1914.	City Bank & Trust Co.....	40.00
64	Oct. 1, 1914.	W. T. Hogg.....	21.70
65	Oct. 27, 1914.	F. D. Daubert.....	8.00
66	Oct. 27, 1914.	Tulane Press.....	8.90
67	Oct. 27, 1914.	W. T. Hogg.....	22.35
68	Nov. 21, 1914.	Kokosky & Co.....	100.00
69	Nov. 21, 1914.	C. C. Duble.....	1.75
71	Nov. 21, 1914.	Federation of Non-Sect. Charities.....	1.00
72	Nov. 21, 1914.	F. D. Daubert.....	8.00
73	Nov. 21, 1914.	Assn. Eng. Societies.....	100.00
74	Nov. 21, 1914.	W. T. Hogg.....	23.10
75	Dec. 21, 1914.	Tulane Press.....	35.45
76	Dec. 21, 1914.	Searcy & Pfaff.....	18.75
77	Dec. 21, 1914.	Kokosky & Co.....	50.00
78	Dec. 21, 1914.	F. Daubert.....	9.00
79	Dec. 21, 1914.	Engineering Publishing Co.....	2.00
80	Dec. 21, 1914.	Concrete-Cement Age.....	1.50
81	Dec. 21, 1914.	Engineering Record.....	3.00
82	Dec. 21, 1914.	Engineering News.....	5.00
83	Dec. 21, 1914.	Assn. Engineering Societies.....	81.96
84	Dec. 21, 1914.	W. T. Hogg.....	23.40

\$2,053.16

Balance..... 4.60

\$2,057.76

Respectfully submitted,

E. H. COLEMAN, Treasurer.

Report of the Library Committee.

New Orleans, La., January 9, 1915.

To the President and Members of the Louisiana Engineering Society:

Gentlemen—Your Library Committee has little to report which has not already been covered in previous reports. This is due to the fact that there have not been sufficient funds in the treasury of the Society to warrant the purchase of books which we have planned to get.

We have purchased, and acquired by donation, about 130 volumes at a total cost of \$269.39, and we feel that the acquisition of these books has very much improved our Library. We are sorry to say that we owe Mr. Kokosky a balance of \$81.43 on the books ordered through him.

The records of the Secretary show the status of the Library fund as follows:

Dr.

Oct. 1, 1914.	40 Vol. A. S. C. E.....	\$ 50.00
Nov. 9, 1914.	Kokosky & Co.....	215.97
Dec. 24, 1914.	Kokosky & Co.....	8.76
Dec. 24, 1914.	Searcy & Pfaff, for binding magazines.....	18.75
Dec. 24, 1914.	Subscriptions to magazines.....	16.50
		\$319.98
Dec. 31, 1914.	Balance due Library Fund.....	163.49
Total.....		\$483.47

Cr.

Apr. 16, 1914.	A. S. C. E. Donation.....	\$202.50
Oct. 5.	A. M. Shaw, 6 vols. A. S. C. E. Trans.....	12.00
Jan. 9, 1915.	L. H. Guerin, Concrete Pl. & Rn.....	3.34
Oct. 31, 1914.	October Rent.....	40.00
	One-half Treasurer's balance, 1913.....	145.63
Nov. 30, 1914.	November Rent.....	40.00
Dec. 31, 1914.	December Rent.....	40.00
Total.....		\$483.47

Your committee is particularly anxious to secure complete files of the publications of several of the National Engineering Societies, and we hope that the funds will soon be available. It will be necessary to have our 1914 periodicals bound, and also some of the A. S. C. E. Transactions.

The new books should be properly labeled and indexed in our card system and this work will entail a small outlay for the services of someone to do the work.

The register shows that the new books are being used and, therefore, we conclude that our labors have not been in vain.

As requested by the Board of Direction, your committee submits the following as the list of reference books which should never be taken from the Library:

American Civil Engineers' Pocket Book—Merriman.
American Electricians' Handbook—Croft.
Architects' & Builders' Pocket Book—Kidder.
Civil Engineers' Pocket Book—Frye.
Civil Engineers' Pocket Book—Trautwine.
Cane Sugar Manufacturers' & Chemists' Handbook—Spencer.
Cost Data—Gillette.
Electrical Engineers' Pocket Book—Foster.
Highway Engineers' Handbook—Harger & Bonney.
Mechanical Engineers' Pocket Book—Kent.
Standard Handbook for Electrical Engineers.
Any other reference book such as above.

We believe that two weeks should constitute the maximum time that any book may be kept out of the Library, and if this rule is not already provided for in the By-Laws, we would strongly recommend that the Society establish such a rule and insist on its enforcement.

We sincerely hope that back dues will be collected very soon in order that we may be able to carry on this work of building up the Library. To impress upon you that we mean what we say in this matter, the members of your committee are transmitting herewith their dues in full for 1915, together with the dues in full for L. H. Guerin for good measure. We also transmit \$3.34 collected from Mr. L. H. Guerin for "Concrete Plain and Reinforced,"—Taylor & Thompson, which, according to the register, was taken from the Library by Mr. Guerin some years ago, and there is no record of its having been returned, nor was it in the Library until we recently purchased a copy at a cost of \$3.34.

Respectfully submitted,

SAMUEL YOUNG,
LEO S. WEIL,
L. C. DATZ,

Committee.

Regular Meeting of the Board of Direction, Feb. 8, 1915.

The meeting was called to order with President Datz in the chair. Messrs. Coleman, Dusenbury, Gregory, Olsen, Williams, Young and Hogg were present.

Minutes of the last meeting were read and approved.

A communication from the International Engineering Congress, San Francisco, 1915, was read. The Congress urged our Society to become a member and to appoint delegates to the Congress to be held September 20-25, 1915. It was moved, seconded and carried that the matter be

referred to the Society, with recommendation to join, and subscribe to entire set of proceedings.

The list of members delinquent for 1914 dues was read and the Secretary was ordered to send registered letters to those members with request for return cards.

The resignation of Mr. John L. Porter, laid over from the January meeting, was accepted. The resignation of Mr. W. B. Moses, laid over from the January meeting, was laid over. The resignation of Mr. J. J. Ganucheau was accepted.

The following bills were approved:

Tulane Press, printing and stationery.....	\$ 54.45
F. M. Norman, collections \$184.....	18.40
Galatoire's Restaurant, banquet.....	144.30
A. M. Shaw, fees to waiters at banquet.....	10.00
Geo. L. O'Connell, music at banquet.....	20.00
W. T. Hogg, Secretary, salary and incidentals.....	23.25

The subscriptions to the *American Architect and Brickbuilder* were referred to the Library Committee.

The financial report of the Secretary was read and accepted.

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Society, Feb. 8, 1915.

The meeting was called to order with President Datz in the chair and 40 members present.

The minutes of the last meeting were read and approved.

Mr. Young, chairman of the Library Committee, called attention to the recommendation in the committee's annual report, that books should not be kept out of the Library longer than two weeks, and that the Pocket Books should not be taken out of the Library. The President suggested that the committee look up the rules regulating the Library, and if they could not be located, to draw up a set of rules.

A communication from Mr. Robert Glenk, curator of the State Museum, was read. Mr. Glenk acknowledged with thanks the token the Society presented to him in appreciation of his efforts in behalf of the Society's welfare. The communication was ordered filed.

A communication from the International Engineering Congress, San Francisco, 1915, was read. The Congress urged our Society to become a member, and to appoint delegates to the Congress to be held September 20-25, 1915. The Board of Direction recommended that the Society join the Congress and subscribe to the entire set of proceedings. Mr. A. M. Shaw moved that the recommendation of the Board of Direction be approved. The motion was duly seconded and carried.

Mr. Garsaud of the State Board of Examiners for Civil Engineers, reported that he had a short interview with the Governor, and that the

Governor stated that he would comply with the wishes of the Society as given in our letter of Jan. 24, 1915. Mr. Garsaud stated that the Governor agreed with the Society and the Board in that the Act 200 of 1914 did not create a new Board. Mr. Garsaud further stated that of the 587 Engineers and 101 Surveyors on the original list of 1908, 241 Engineers and 60 Surveyors had qualified under the new Act.

Prof. Anderson, Editor of the Journal, reported that the committee had decided to have six issues of the Journal per annum. Prof. Anderson stated the first issue would be out in about two weeks.

The technical exercises were then held. The annual address of President Williams, entitled "The Ethics of the Contractor," was discussed by Messrs. J. F. Coleman and A. M. Shaw; their discussions were followed by brief discussions from the majority of the members present. After the discussion, the meeting adjourned to the collation.

W. T. HOGG, Secretary.

Regular Meeting of the Board of Direction, Mar. 8, 1915.

The meeting was called to order with President Datz in the chair. Messrs. Coleman, Gregory, Williams, Young and Hogg were present.

Minutes of the last meeting were read and approved.

Communications from the Engineers' Club of Philadelphia, the Detroit Engineering Society, Association of Engineering Societies, Cleveland Engineering Society, Technology Club of Syracuse, acknowledging receipt of our Proceedings and offering their Proceedings, were read and ordered filed.

The resignations of Messrs. Ivan J. Wolfe and J. I. Giacomino were read. As these men were student members, their resignations were accepted. The resignation of Mr. J. H. Lewis was read. As Mr. Lewis is a non-resident member, the Secretary was directed to inform him that his resignation could not be accepted before the end of 1915. The resignation of Mr. W. B. Moses was laid over to the next meeting.

The Secretary was directed to look up the records of the Society to find out if Messrs. Foster Olroyd and James W. Billingsley had been members of the Society before 1914, as Mr. Billingsley had been admitted as a new member in 1914, and Mr. Olroyd's application for membership was pending, and to find out if they had been indebted to the Society at the time of their withdrawal, and to inform them of his findings.

Mr. Young reported that the committee appointed to collect an offering from the members for a present to Mr. Glenk, Curator of the State Museum, had collected \$26.00, and the present cost \$33.00. It was moved and duly seconded and carried, that the balance be paid to Mr. Young out of the general fund of the Society.

The Secretary was directed to look up the time when the books were audited last, and report to the Auditing Committee. A number

of applications were read and ordered passed to ballot subject to the action of the Membership Committee. A communication from the Philadelphia Book Co. was referred to the joint action of the Library and Journal Committees. The details of entering the Journal as second-class matter in the post office was referred to the Journal Committee.

The following bills were approved:

Tulane University Press, printing and stationery.....	\$
Searcy & Pfaff, menus at banquet.....	13.50
Crescent Cigar & Tobacco Co., cigars at banquet.....	9.50
Engineering Magazine Co., Eng. Index 1914.....	3.00
F. D. Daubert, refreshments at February meeting.....	9.50
W. T. Hogg, Secretary, salary and incidentals.....	23.05

The financial report of the Secretary was read and approved.

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Society, Mar. 8, 1915.

The meeting was called to order with President Datz in the chair and 45 members present.

The minutes of the last meeting were read and approved.

Mr. Shaw moved that since the members have heard with shock and sorrow of the death of Mr. Edward Wisner, and since the Society had always received marked recognition from Mr. Wisner, although not a member of the Society, that the President appoint a committee to draw up resolutions on the death of Mr. Wisner at once. The motion was seconded by Messrs. J. F. Coleman, F. M. Kerr, and W. B. Gregory, and carried. Messrs. Shaw, Gregory and Robert were appointed on this committee.

Major F. M. Kerr stated that he desired to express his appreciation of the new Journal and compliment the Editor. Mr. Coleman stated that we all want to compliment the Editor.

Communications from the Engineers' Club of Philadelphia, the Detroit Engineering Society, the Association of Engineering Societies, the Cleveland Engineering Society, and the Technology Club of Syracuse, were read. The communication acknowledged receipt of our new Journal with compliments, and offered their Proceedings in exchange.

A communication from the American Chemical Society, inviting the members of our Society to attend their Symposium on Industrial Chemistry, April 1, 1915, was read, and ordered received and acknowledged with thanks.

The technical exercises of the evening were then held. Major F. M. Kerr read a very interesting paper entitled "Forty-four Years with the Levees in Louisiana." The paper was followed by considerable discus-

sion on levees in general, and, especially, on the question of spillways for the lower Mississippi.

The committee appointed to draw up the resolutions on Mr. Wisner's death then presented their resolutions, which were read by the Secretary. The committee requested that a copy of the resolutions be forwarded to his family, and another copy be spread upon the minutes of the Society.

There being no further business, the meeting adjourned to the usual collation.

W. T. HOGG. Secretary.

Recent Additions to the Library.

The Preservation of Structural Timber—Weiss.

Proceedings of the following Societies, in addition to those previously noted, will be received regularly:

Engineers' Society of Pennsylvania.

Engineers' Club of Philadelphia.

Pacific Northwestern Society of Engineers.

Engineers' Club of Dayton, Ohio.

PROCEEDINGS
—OF THE—
LOUISIANA ENGINEERING SOCIETY

VOL. I

JUNE, 1915

No. 3

CONTENTS

EDITORIAL NOTES AND COMMENT:

	PAGE
The New Orleans Cotton Warehouses.....	123
The Handling of Freight on Inland Waterways.....	124
Written Discussion on Papers Presented to the Society.....	125
To Recent Engineering Graduates.....	126
Rules and Regulations Governing the Library	127
Tables of Constants	128
New Members	129
Cuts for the Journal	130

PAPERS AND DISCUSSIONS:

Economic Features Controlling the Design of the Cotton Warehouses and Terminal of the State of Louisiana for the Board of Commissioners of the Port of New Orleans. <i>By Wm. von Phul</i>	131
Discussion.....	153
A Suggestion for Handling Freight on Interior Water- ways. <i>By H. L. Hutson</i>	158

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY	164
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DIRECTORY OF OFFICERS.

L. C. DATZ, President, 201 Baronne Street.
SAMUEL YOUNG, Vice-President, 1002 Perrin Building.
E. H. COLEMAN, Treasurer, 920 Hibernia Building.
W. T. HOGG, Secretary, Tulane University, P. O. Station 20.

DIRECTORS.

W. H. WILLIAMS, 1016 Hibernia Building.
W. B. GREGORY, Tulane University of Louisiana.
A. T. DUSENBURY, 901 Maison Blanche Building.
OLE K. OLSEN, 823 Perdido Street.

The headquarters of the Society are in the State Museum
Building, Jackson Square.

Address all business communications to W. T. Hogg, Secretary,
P. O. Station 20, New Orleans, La.

The Proceedings of the Louisiana Engineering Society

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DOUGLAS ANDERSON, Editor.

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PROCEEDINGS
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VOL. I

JUNE, 1915

No. 3

EDITORIAL NOTES AND COMMENT

The New Orleans Cotton Warehouses.—Cotton represents approximately fifty per cent. of the value of the exports out of the Port of New Orleans. In 1895 New Orleans exported 2,580,000 bales of cotton, while in the same period Galveston exported 1,650,000 bales, and Savannah exported 950,000 bales. For the year ending August 31, 1914, New Orleans exported 1,890,750 bales as against 3,356,460 bales for Galveston, and 1,822,370 bales for Savannah. These significant figures, showing the changes that have taken place in the past twenty years, are taken from Mr. von Phul's very interesting paper dealing with the economic features of the design of the cotton warehouses for the Port of New Orleans. This very striking change in the relative positions of New Orleans and Galveston as cotton shipping points is due to a variety of causes, but as is clearly pointed out in the paper, the two chief factors in the development of the cotton export business of any port are, first, the equitable adjustment of transportation rates among the different ports contiguous to the cotton producing districts, and, second, the facilities which the port authorities provide for the proper storage and handling of the cotton on the wharves.

With the first of the above mentioned factors equitably adjusted and handled, as it now is, by the Interstate Commerce Commission, the volume of the cotton export business at any port will be largely determined by the convenience and efficiency of the ways and means provided for the proper care and handling of the cotton at the waterfront.

The importance of these facilities to the Port of New Orleans, and the magnitude of the undertaking, may be realized somewhat from the statement that the plans for the warehouses and terminals involve an estimated expenditure of approximately \$3,000,000.

Mr. von Phul further points out the great economy of the single story warehouse in which the cotton is piled in tiers as compared with the multi-story type in which the bales are stored on end in a single tier per floor. The economy of handling the bales in a warehouse of the single story type is further increased by the development of improved methods of removing the bales from the tiers and of transferring them from place to place with electric cranes and tractors.

These warehouses as designed have also the additional advantage of being suitable for the handling of other commodities coming through this port, such as coffee, rice, jute, sisal, tobacco, etc.

The Handling of Freight on Inland Waterways.—While the wharves of the Port of New Orleans are supplied with mechanical devices for handling certain special kinds of freight, such, for instance, as the banana unloaders and the new mechanical arrangements for handling cotton now being designed in connection with the warehouse plan, yet there is a striking lack of use of any sort of mechanical devices for the handling of miscellaneous freight. Mr. Hutson's paper calls attention to this deficiency as far as New Orleans is concerned, and also points out how such devices could be applied with great advantage to the problem of handling freight on all of our inland waterways. Nature has been lavish in her bestowal of such waterways upon the State of Louisiana, and their proper development and utilization as avenues of traffic is one of the great factors in the future prosperity of the State. The gasoline or oil engine as applied to marine propulsion has already become a most important factor in this problem, permitting of the use of boats or barges of small or medium size best adapted to the particular kind of freight to be handled and to the width and depth of the water-

ways to be traversed. Anything else which will increase the rapidity and efficiency of handling the freight will naturally serve to increase the economy of this system of transportation. Mr. Hutson's paper is of timely interest, therefore, and the point should be emphasized that his suggestions involve the application to this problem of devices for freight handling which are already upon the market.

Written Discussion on Papers Presented to the Society.—

The Chairman of the Program Committee has brought to the attention of the Editor a matter which calls for some comment here in order to bring it to the attention of the members. A number of years ago it was the custom of the Society to have the paper read at one meeting and then hold the discussion on it at the meeting the following month. This did not prove to be a very good plan, for very few members ever took the trouble to prepare discussions, and then also after the lapse of a month the various points which might have lead to discussion and comment had been forgotten by most of those who had heard the original paper. Later on by tacit consent this plan was given up and discussion was called for immediately after the reading of the paper. This plan has many advantages over the other so far as spontaniety of discussion is concerned, but it has its drawbacks also, one of the principal reasons for which being the inability of many men, even though well-informed and otherwise efficient, to speak extemporaneously upon a subject brought to their attention only a short while previously by hearing the paper read for the first time. 1

Of course, the ideal method would be to have a preliminary draft of the paper published beforehand and distributed to the members. This is scarcely feasible at the present time for the Louisiana Engineering Society for two reasons; first, it is often difficult for the author to have his paper prepared sufficiently far in advance for this, and second, the financial status of our journal does not permit of this extra expense.

Now it has been generally understood that any of the papers published in the PROCEEDINGS are open to discussion which may be submitted in writing and published in a subsequent issue. It

so happens, however, with our journal that a paper is, as a rule, not published until some six or eight weeks after it has been presented to the Society. This lapse of time between the reading of the paper and the issue of the journal containing the paper gives ample opportunity for any member to communicate a written discussion thereon. This presents the very decided advantage that the discussion appears in the same issue as the original paper and the two may thus be read together and compared.

By way of illustration of this idea the attention of members is called to the fact that the very interesting paper of Mr. C. M. Kerr upon "Louisiana State Highways" will appear in the August issue. This will afford ample time and opportunity for any member who so desires to communicate to the PROCEEDINGS in writing any remarks or additional data which he thinks would add to the value of the paper. The Editor trusts that the members will bear this matter carefully in mind and that subsequent issues of the PROCEEDINGS will have the value of their contents greatly enhanced by these written discussions.

To Recent Engineering Graduates.—A fairly large percentage of the membership of this Society consists of young men who have recently graduated from Tulane University, from Louisiana State University, or from some of the technical schools in neighboring States. These men should realize the importance of keeping in touch with their respective institutions on account of the possible opportunity of bettering themselves by a change of position, or of securing a position when one happens to be out of a job. Practicing engineers and contractors are more and more adopting the custom of applying to the colleges when they need young men to fill vacancies. It is to the advantage of the recent graduate, therefore, to keep his name and present address on file with the university authorities, and to inform them promptly of any change of address. By so doing he will be in a position to learn of any requests for men to fill vacancies which may come in to the university authorities.

Rules and Regulations Governing the Library.—In order that the Library of Louisiana Engineering Society may be of the greatest benefit to the membership as a whole, it is essential that there be some well defined system governing its use.

The following rules and regulations have been adopted by the Society with a view to accomplishing the result mentioned above:

1. The Library of the Louisiana Engineering Society is open to the use of any person who may have occasion to consult Engineering literature, but only members (including all grades) may have the privilege of withdrawing books and other publications from the Library building.

2. There being no Librarian to take charge of the issuance of books or other publications, it shall be the duty of members making withdrawals from the Library, to record the same in the register provided for that purpose.

3. All books and publications are subject to withdrawal, with the following exceptions: viz., "Engineers' Handbooks," "Engineers' Pocket Books," all volumes of Engineering Index Annual, index volumes of any publications, and most recent issues of periodicals.

4. No book or publication shall be withheld from the Library for a longer period than fifteen days without being re-registered, and in no case shall a book or publication be withheld by a member for a longer period than thirty consecutive days.

5. Failure of any member to return a book or publication within the fifteen-day period provided, will subject him to an assessment of two cents per day per book or publication from the fifteenth day after withdrawal until return or re-registering of book or publication. Failure to return, or re-register book or publication within the thirty-day period provided shall subject the member to an assessment equal to the cost of the book or publication withdrawn.

6. It shall be the duty of the Secretary to mail notices to members, calling attention to their infractions of the foregoing Library Rules, and to include in quarterly statements to members, the assessments made against them, and such sums as may be assessed shall become payable to the Society on the same basis as regular dues. Such Library assessments as may be collected

by the Secretary, as provided for hereinabove, shall be placed to the credit of the Library fund.

Adopted by the Society at a regular meeting, held on the tenth (10th) day of May, 1915.

Tables of Constants.—The Society has recently received from the University of Chicago Press two volumes of the Annual Tables of Constants, compiled by the International Commission. These were accompanied with the following letter:

The University of Chicago,
Department of Chemistry,
April 7, 1915.

*Secretary, Engineers' Society of Louisiana,
New Orleans, La.:*

Dear Sir—At the request of Dr. Marie, Secretary of the International Commission on Annual Tables of Constants, I have asked the University of Chicago Press to send you the separate prints of the parts of Volume III of the Annual Tables on electricity and metallurgy. We should be much obliged to you if you would bring the fact that these parts are published separately to the attention of your members and if you would have each part reviewed as a separate part in any journals connected with your Society. It is the hope of the International Commission to work in close touch with the engineering societies of the world.

Yours cordially,

J. STIEGLITZ,
Chairman of the American Commissioners.

The tables are all in French and the data are given in metric units. They are scarcely, therefore, to be considered in the light of ready reference tables for the practicing engineer, but their field of usefulness would lie rather with the engineer or teacher who is carrying on some special line of investigation in certain subjects to which the tables refer. A brief review of the contents will serve to indicate the character of the information set forth in the tables.

One volume is devoted entirely to Electricity and Magnetism, containing tables of constants of conductivity of metals, electrolytes and other conducting substances, variation of electrical resistance with different factors, dielectric constants, break-down potentials, electric waves, hysteresis, magnetic rotation, normal cells, Weston cell, etc.

The second volume consists of tables of properties of various materials, a few of which are indicated in the following headings: Strength of Wooden Piles, Strength of Portland Cements as influenced by Composition and Age, Strength of Slag Concrete, Wear of Cement Mortar, Mechanical Properties of Silk for Balloon Envelopes, Resistance to the Passage of Air Through Pipes, Heat Efficiency of American Coals, Transmission of Steam Heat Through Partitions, etc.

New Members.—The following new members have been elected to the Society:

RESIDENT MEMBERS.

Harry L. Villere, Assistant Engineer with Board of Port Commissioners.

John A. Silsbee, with C. B. Huggins, New Orleans, La.

Harry L. McLean, Superintendent Algiers Railway and Light Company.

Harold H. Gibson, with New Orleans Southern and Grand Isle Railway and affiliated companies.

NON-RESIDENT MEMBERS.

Frederick H. Frankland, Bridge Engineer, Highway Department, Calcasieu Parish, Lake Charles, La.

H. F. McDermott, District Sales Manager for Wm. Wharton & Co., Philadelphia, Pa.

JUNIOR MEMBERS.

James J. Bulliung, Draftsman with New Orleans Railway and Light Company.

Frank L. Holt, with New Orleans Railway and Light Co.

ASSOCIATE MEMBER.

Edwin C. Brown, Travelling Salesman, 4215 Locust street, Kansas City, Mo.

Cuts for the Journal.—Members who propose to illustrate their technical papers with drawings are requested to bear in mind the following points: The standard size of page in the PROCEEDINGS is 4x7 inches. Drawings from which full page cuts are to be made should therefore have their dimensions some multiple of these, i. e., 8x14, 12x21, or 16x28. For a half page cut the dimensions are 3x4 inches and the drawings should be in the same proportion as indicated above. Such drawings should be made on perfectly white drawing paper with distinct black lines. Tracings may also be used when made on a good body tracing cloth. For the reproduction of photographs well made prints should be furnished.



PERSPECTIVE OF COTTON WAREHOUSES AND TERMINAL

PAPERS AND DISCUSSIONS

ECONOMIC FEATURES CONTROLLING THE DESIGN OF THE COTTON WAREHOUSES AND TERMINAL OF THE STATE OF LOUISIANA FOR THE BOARD OF COMMISSIONERS OF THE PORT OF NEW ORLEANS.

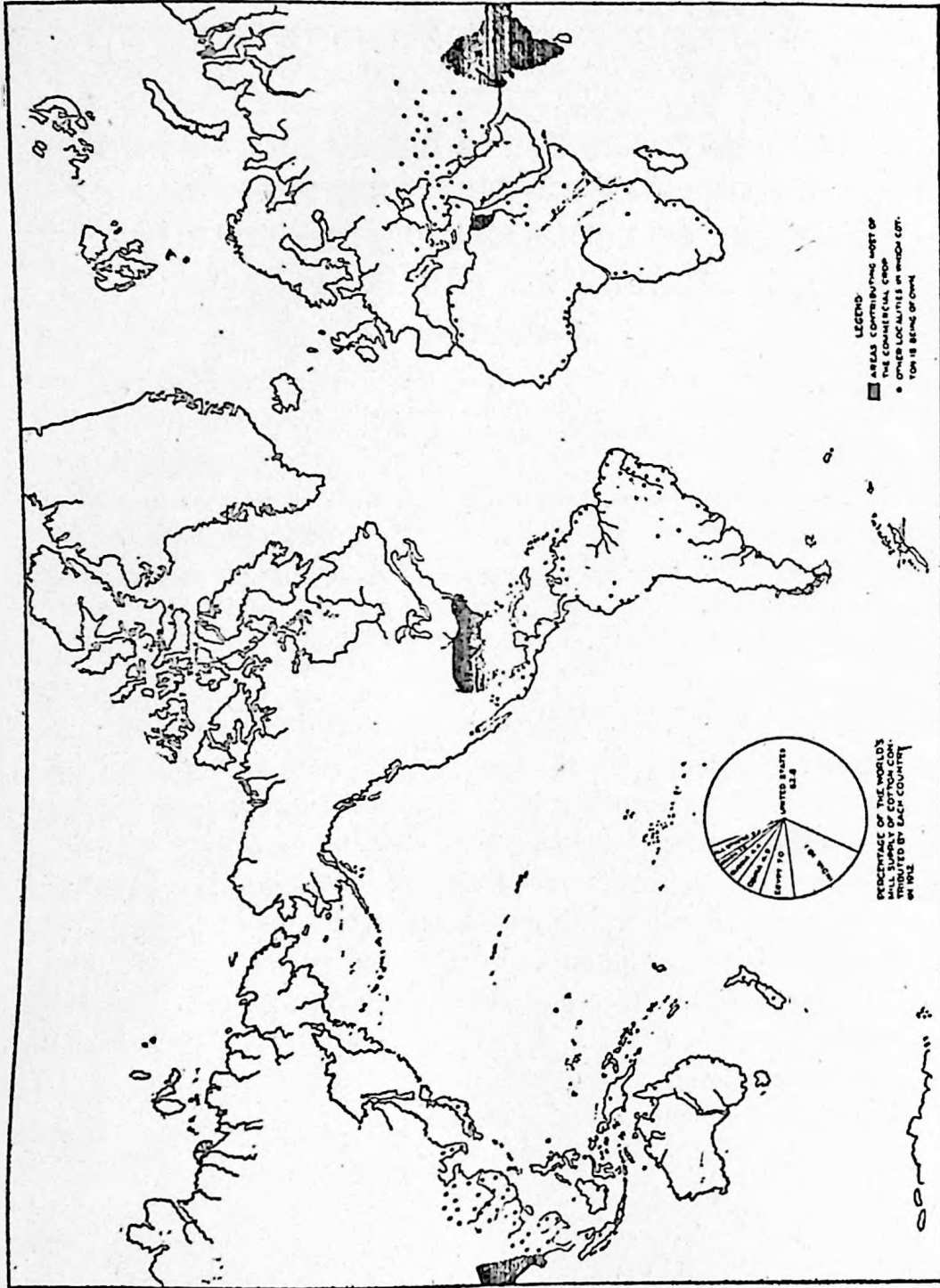
By

WM. VON PHUL.

(Read before the Society, April 12, 1915.)

(As originally presented before the Society, Mr. von Phul's paper was illustrated with a number of very interesting lantern slides showing the methods of storing and handling package freight in the principal ports of Europe, and also showing the plans for the new warehouses now being constructed in New Orleans. It was impracticable to reproduce all of these illustrations in the *Proceedings*, so only a portion of them, which serve to show the principal features of the cotton warehouses as developed for the port of New Orleans, are presented herewith.—Editor.)

As the commerce of a nation is not definitely fixed at any port, therefore, each port to improve or even to maintain its position in relation to other ports must continually develop its facilities in advance of trade. New Orleans as a port will develop in proportion to the growth of its hinterland, its location with reference to general lines of rail, river and ocean trade routes, the ability of the equipment of the port to rapidly and economically handle, store and transport commodities from rail or river to ocean carriers and vice versa, and the establishment of adequate national and international banking facilities. In the past, New Orleans as a port, has, due to local or foreign causes experienced periods of rapid rise as well as of relative depression, but in general the port development has been uniformly forward. For several successive years previous to 1860, New Orleans exceeded the port of New York in the value of its exports and ranked second among the ports of the United States in total value of imports and exports. During the decade from 1861 to 1870, New Orleans ranked third, New York and Boston



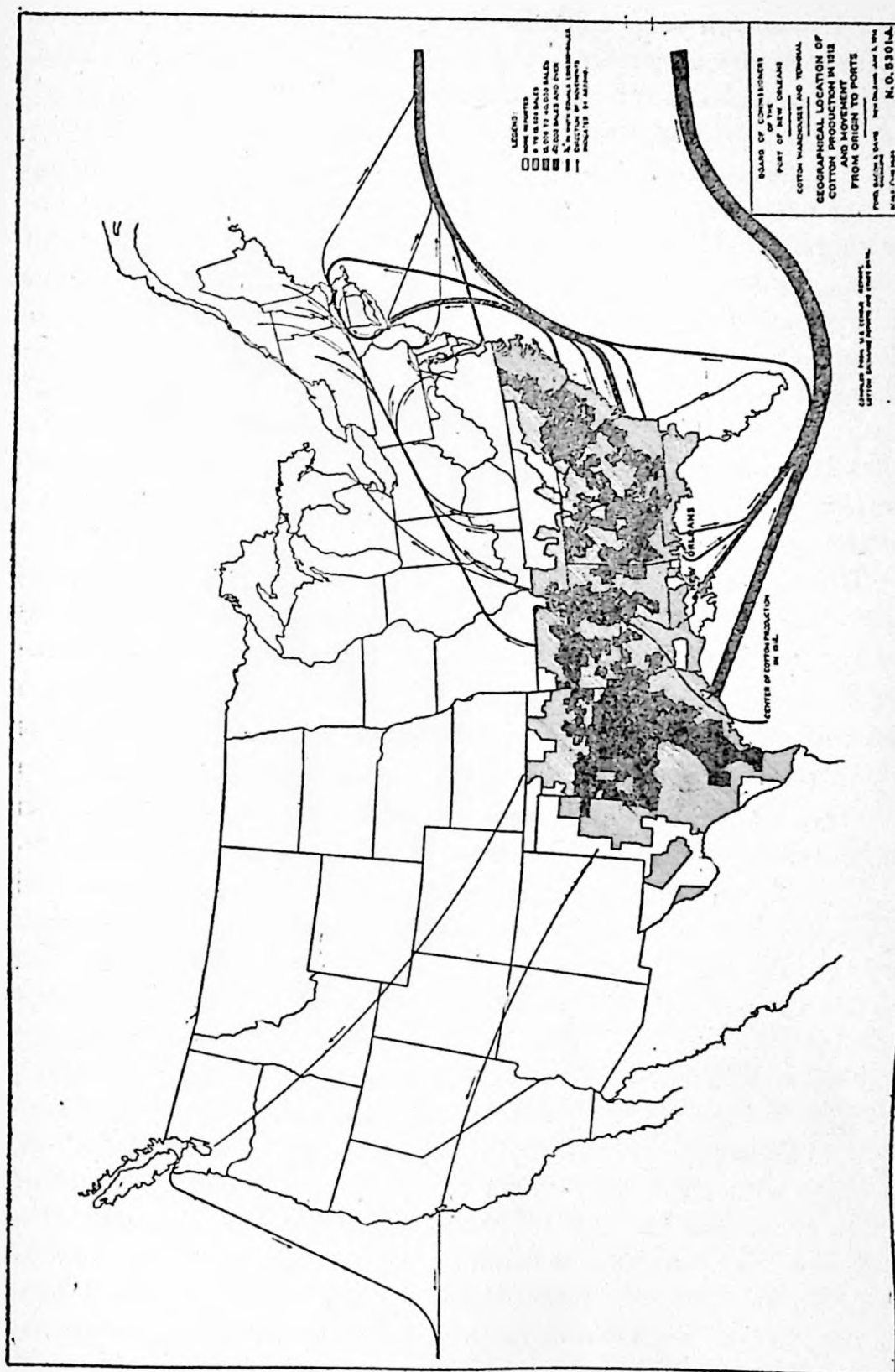
COTTON PRODUCING AREA OF THE WORLD

being first and second. From 1871 to 1880, New Orleans was second in the value of total foreign trade, but from 1881 to 1900, Boston took second place, while New Orleans was again the second port shortly after 1900, but was a few years later displaced by Galveston, and remained third in rank of the ports of the United States, until the year ended June 30, 1914, when the total foreign trade of New Orleans exceeded that of Galveston by \$15,000,000, New Orleans thus once more ranking second in value of exports and imports. The value of the imports are approximately one-half that of the exports, a ratio of imports to exports that is only exceeded by that of New York. This relatively high ratio assures to New Orleans an advantage not possessed by any other Gulf or South Atlantic Port, since as a Port of two-way operation, New Orleans is more attractive to the steamship lines. The main commodities exported, are cotton, wheat, leaf tobacco and lumber, while of the imports, coffee, sisal and fruit compose the chief items. Of the total exports, cotton represents approximately fifty per cent. in value.

The effect of transportation rates on the movement of general trade commodities, as well as the effect of the Port facilities for rapidly and economically transporting commodities through the Port, are both illustrated in the history of the cotton trade of New Orleans and that of Galveston. Until 1890, New Orleans was preëminently the cotton port of the United States, handling for the year ended August 31, 1890, approximately 2,000,000 bales of cotton as compared with 960,000 bales for Savannah and 860,000 bales for Galveston. In 1895, New Orleans handled approximately 2,580,000 bales as compared with 950,000 for Savannah and 1,650,000 for Galveston. In 1900 New Orleans handled only 1,870,000 bales while Savannah had increased to 1,090,000 and Galveston to 1,710,000. In 1905, New Orleans as a cotton shipping port, had dropped from first place to second, handling 2,700,000 bales compared with 2,880,000 bales at Galveston and 1,880,000 bales at Savannah, since which date New Orleans has, with the exception of the year ended August 31, 1912, when the exports at Savannah exceeded those at New Orleans, maintained second place, the total number of bales handled for the year ended August 31, 1914, being for Galveston 3,356,460, New Orleans 1,890,750 and Savannah 1,822,370.

As indicated above, the cotton passing through the Port of New Orleans, was influenced by the changed transportation conditions and the lack of economical facilities for the handling, marketing and shipping of cotton at the Port. The decline of river transportation seriously affected the shipment of cotton through New Orleans, while the tremendous development of the cotton producing area of Texas and the fact that the railroads of Texas previous to the present season, made a lower freight rate to Galveston than to New Orleans from the majority of Texas points, resulted in the rapid rise of Galveston as a cotton port. The center of the cotton production of the United States is located in the eastern part of the State of Mississippi near the boundary line between the States of Arkansas and Louisiana, a distance of 225 miles from New Orleans, 360 miles from Galveston and 575 miles from Savannah. The cotton producing center of Texas is about 30 miles south from Dallas, a distance of 456 miles from New Orleans and 240 miles from Galveston. Since the decision of the United States Supreme Court upholding the Interstate Commerce Commission in the Shreveport rate case, the railroads have made effective from Texas common points, the same rate on cotton shipped to New Orleans as to Galveston. Texas produces from thirty-five to forty per cent. of the cotton of the United States, as much as the States of Alabama, Georgia, North and South Carolina. The effect, therefore, of this decision will be to make accessible to the Port of New Orleans a very much larger proportion of the cotton crop than heretofore.

It is assumed that the cotton produced in the States of Louisiana, Mississippi and Arkansas is directly tributary to New Orleans as the port through which it should move at least expense, then New Orleans has been receiving annually only about two-thirds of such cotton. If, in addition to the crops of Louisiana, Mississippi and Arkansas, one-fourth of the crop of Tennessee, Oklahoma and Texas is considered as accessible to New Orleans, the port is receiving only forty per cent, of the cotton that could as advantageously move through New Orleans as through any competing port. In other words, based on the crop of 1913-1914, New Orleans received 1,890,758 bales out of 2,865,000 bales produced in the territory immediately tributary to



New Orleans, or only 1,890,758 out of 4,572,750 bales produced in the territory accessible to the Port. With transportation rates equitably adjusted and with proper terminal and shipping facilities at the Port for rapidly and economically storing, transporting and shipping of cotton, it is possible for New Orleans, based on the same average annual cotton production, to increase the number of bales shipped through the port, two and one-half times. Transportation rates are to-day under the control of the Interstate Commerce Commission and the railroads will not be allowed to impose unjust or discriminatory rates, such as possibly may have been in effect in the past. The second main feature in the development of the cotton business of New Orleans is primarily dependent upon the facilities which the port provides and upon the use that the cotton merchants of New Orleans make of these facilities.

The economy of concentration is as real in the handling and marketing of cotton, as in other industries, and by the concentration of capacities, machinery and facilities, a more effective organization may be employed. At Memphis this fact had been recognized and there has been established what is the largest cotton concentrating and storage plant now in operation in the country, while at both Houston and Galveston, large modern concentrating plants have also been established. In New Orleans in 1908 a movement, for the erection of a similar plant was first started. This movement, which originated with the members of the New Orleans Cotton Exchange divided into two factions, one of which supported a privately owned and operated terminal, such as was in operation at Memphis, while the other faction was in favor of a State owned and operated terminal. Largely for the reason that the port facilities were under State control and operation and that a cotton terminal operated in connection with the present port facilities would, on account of State ownership and control, furnish a satisfactory service at a less cost than was possible under private ownership and operation, the decision was reached that the Board of Commissioners of the Port of New Orleans as an agent of the State of Louisiana, should build and operate a cotton warehouse and terminal. As a result of this decision, in 1910 the Legislature passed an act

The present method of storing cotton, as followed not only in New Orleans, but in most of the cotton warehouses of this country, is to pile or tier the cotton on the flat from seven to ten bales high, so dividing the piles by aisles that the end of every bale is readily accessible for examination. This method of piling is the distinctive feature made necessary by the conditions governing the marketing of cotton and which primarily distinguishes the present method used in New Orleans from the bulk piling used in the cotton safes of the Trafford Park Estates. The present method, therefore, while economical in ground area, has the disadvantage that in order to remove any particular bale from the pile, it is frequently necessary to remove a number of bales before the particular bale can be reached. This operation is not only slow, but expensive, and unless some plan was devised whereby any particular bale could be quickly and economically removed from the pile, it was a serious drawback to the adoption of any storage plan where it was necessary to pile the cotton to secure the desired capacity. On the other hand, lack of ground area, if the bales could be placed only one high on end, required the erection of multi-story warehouses, which in turn involved excessive cost, possibly serious construction difficulties and an intricate and expensive conveying system. Careful estimates indicated that depending upon the type of construction the cost of a multi-story warehouse, per bale of storage capacity, exclusive of the cost of real estate, was in excess of \$15.00 as compared with \$4.00 for the single story type. The annual interest on the warehouse bonds is five per cent and the sinking fund requires practically one per cent. per annum additional, so that with the cost of repairs and renewals and a very small contingency reserve, the fixed charges on the warehouses annually would be approximately eight per cent. This means that if a bale of cotton occupies the warehouse for one year, an expense of \$1.20 for fixed charges alone would have to be taxed against the bale in the multi-story warehouse, as compared with 32 cents per bale in the single story warehouse. Even more important was the investment necessary to provide the required storage capacity. Only \$3,000,000 was available for the construction of the entire terminal and a capacity of only 250,000 bales, if the multi-story type

were adopted, would require an expenditure of over \$3,500,000 as compared with an expenditure of approximately \$1,000,000 for the single story type. It was possible, therefore, to build the single story type of warehouse, even if necessary later to remove the bales from the piles by hand labor, and yet have the total cost of operation less per bale than if the bales were not tiered, but stored singly in a warehouse of the multi-story type. The development of the mechanical handling and conveying equipment, however, removed all objections to the single story type of warehouse. The conveying equipment for the warehouse compartments consists of overhead high speed electric traveling cranes and for use from the compartments to the wharf an elevated runway on which electric tractors and trail cars operate. The electric cranes are designed to travel the full length of each compartment and by the travel of the trolley on the crane bridge will be able to serve every square foot of the area of each compartment. These cranes may also be transferred from one compartment to any other, thus obviating the necessity of installing a crane in each compartment. Only one operator is required, and by the use of an automatic grapple this operator can place the cotton in the warehouse at any designated location, or load it directly onto a tractor or trailer for moving to the wharf. When necessary to remove a bale from the pile a second device is used in connection with the crane, which requires the help of another operator. With this device any bale may be removed from the pile without damage to the cotton or covering, and as the entire operation is completed within three minutes, the labor cost is very small.

For the movement of cotton from the warehouse to the wharf the electric tractor and trailer offer the greatest possibilities. The Committee on Yards and Terminals of the American Railway Engineering Association at the annual convention held March 16 to March 18, 1915, stated that the electric motor truck is of especial advantage under proper conditions and gives greatest flexibility and facility of distribution when used to haul trail cars. The elevated runway on which the tractors and trailers will operate, allow of the rapid movement of cotton from any compartment in the terminal to any other compartment, or to

any part of the wharf, without loss of time, due to track congestion, switch operation or similar difficulties. The runway is so arranged as to provide not only for double track operation, but also for loop operation wherein the movement of the tractor may be continually forward from its starting point until it has returned to the same point. In addition to the elevated runway, which is, of course, free from any obstruction, there is a similar runway at the level of the ground, which, while it has the objection of crossing the railroad tracks on a bridge, in effect doubles the normal capacity of the plant for emergencies or peak load operation. As will be noted, the entire handling and conveying machinery is composed of standard equipment that has proved both economical and reliable in continued operation. The overhead electric travelling cranes, the elevated runway for tractor or trailer operation and electrically driven trucks, have all been developed to a high state of efficiency.

In addition to the transportation of the cotton by means of the runways and electric trains, the entire yard trackage, together with the locomotive and freight cars or other equipment, may be used in the transfer of cotton from the warehouse compartments to wharf and vice versa. Railroad transportation facilities will be furnished by the New Orleans Public Belt Railroad. The Belt Railroad will construct a large receiving and storing yards on the site which as immediately constructed will have a storage capacity of approximately 2,500 cars, sufficient to accommodate a daily movement of 700 loaded cars or from 30,000 to 35,000 bales of cotton. The delivery of cotton by Public Belt Railroad will do away with all drayage of cotton from the different railroad and steamship terminals to the presses, which will result not only in a more expeditious handling but will materially reduce the cost. On the wharf front, for loading cotton on the ships or receiving it from river boats or lighters, are gantry cranes and continuous conveyors.

A further advantage of the type of warehouse, terminal and equipment as adopted, is the suitability of the plant for the use as a general warehouse at such times when not fully required for cotton. There are no limitations due to special features of design of either the warehouse or the conveying machinery that

would lessen the efficiency of the operation of the plant when handling and storing coffee, rice, jute, sisal, tobacco or other standard package commodities. This feature of universal use is extremely important and will enable the plant to operate at maximum earning capacity. For instance, the cotton handling, which begins with the cotton season in August, has reached its maximum in December and rapidly declines until in the Spring and Summer months it is only a small percentage of the maximum, while tobacco, which is an important article of the Port's commerce, is marketed between the close of one cotton season and the opening of the next. Other commodities, as well as general import freight may, therefore, be handled through the warehouse during times when the capacity of the plant is not required for cotton.

Equally important to the success of the plant is its adaptability to two-way operation; that is, the receipt of commodities by rail or river and shipment by vessel or vice versa. The wharf crane, lifting the freight from the vessel, will deposit it on the wharf or on railroad cars for shipment, or on the electric tractor or trailer for delivery to the warehouse as readily as it can lift freight from the wharf to the vessel, while the flexible conveying system and the warehouse cranes can handle with equal efficiency any commodity within the plant or warehouse compartment.

In the handling of cotton as at present followed in New Orleans, Factor's cotton is received either by rail or river and unloaded at the terminal and from there hauled to the compress yard, where it is ranged and sampled and then stored. This cotton is ordinarily received flat or uncompressed. When the cotton is sold by the factor it is turned out, ranged for inspection and weighing, delivered to the Compress, compressed, loaded on drays and delivered to the wharf for shipment.

F. O. B. cotton is delivered to the buyer at the railroad terminal and after inspection, sampling and weighing is either stored by the buyer or moved direct to the wharf. If stored the method of handling is, with the exception of passing through the Compress, practically the same as for the Factor's cotton.

Through cotton may be held in the railroad terminal awaiting

which proposed an amendment to the Constitution of the State of Louisiana, giving the power to the Board of Commissioners of the Port of New Orleans to erect and operate public warehouses, and this act was approved July 5, 1910, and the amendment to the Constitution of the State was adopted at a general election held in November of the same year. A further amendment to the Constitution was adopted in November, 1913, amplifying the powers of the Board of Commissioners of the Port of New Orleans and removing certain restrictions of the act of 1910 relative to the issuance of bonds and payment of interest on such bonds as might be issued for the erection of the warehouses. On May 1, 1914, an issue of \$3,000,000—5% Gold Bonds had been sold and \$3,012,500 was deposited with the Trustee as the net proceeds of such sale.

In determining upon the erection of State warehouses for the Port of New Orleans, the Board of Commissioners decided, on account of the great importance of cotton to the business of the Port, that this commodity would be the first to be handled. The Board had already determined upon the location of the warehouses and the purchase of the site was practically completed at the same time as the sale of the bonds. Before, however, any definite plans could be submitted to the Board, it was necessary to make a careful study, not only of the cotton business of the Port of New Orleans, but of all other principal Ports of this country and such foreign Ports as were engaged in the receipt, transportation and shipment of cotton.

The warehouses and terminal which involved an estimated expenditure of not less than \$3,000,000 have been designed.

1. As part of a comprehensive plan which may be enlarged in storage capacity, terminal trackage and wharf area.
2. At a minimum of cost commensurate with permanent construction and as would insure the greatest protection from fire.
3. To permit the installation of economical, mechanical conveying equipment with its consequent reduction in labor costs.

4. To enable the plant to be operated at maximum earning capacity and therefore when not required for cotton, to provide for the storage of coffee, rice, jute and other standard package commodities.

5. To permit of the receipt and handling of cotton and other commodities from vessels and their transfer to freight cars, adapting the plant to a two-way operation.

6. So as to be adaptable to the present methods of inspecting, weighing and classing cotton as well as to any new methods.

7. So that flat as well as compressed cotton may be handled and stored economically.

8. To handle Factor's cotton, F. O. B. cotton and Through cotton with equal efficiency.

9. To enable the Port of New Orleans to become a deposit market for the cotton supply of the world.

The site selected by the Board for the erection of the cotton warehouses and terminal is located between the River and Leake Avenue and extends from Napoleon Avenue to Soniat Street. This area between the shore line as it existed and Leake Avenue contained approximately sixty-two acres, but by arranging to relocate the wharf line so that the front of the wharf practically coincided with the thirty-foot contour referred to low water, the area was increased to almost eighty acres, or 33 $\frac{1}{3}$ %. In addition to the above area the Board has since acquired the property from Soniat Street to Peters Avenue, thus making available an additional seventy acres, or one hundred and fifty acres in all. As the present development occupies less than sixty acres, there is ample room for expansion at such time as the cotton business of the Port may demand it.

The receipts of cotton at New Orleans during the years from 1905 to 1914, have varied from a maximum of approximately 2,500,000 bales in 1905 to a minimum of 1,342,000 bales in 1910 and for the year 1914 were 1,890,000 bales. With the average crop, therefore, the present plant was designed to have an annual capacity of 2,000,000 bales, divided as follows:

400,000 bales of Consigned or Factor's cotton;

400,000 bales of F. O. B. cotton; that is, cotton sold for delivery at railroad depots, but subject to inspection; and

1,200,000 bales of Through cotton. This cotton is shipped on through bill of lading from the interior points, but under the present regulations governing such shipment is entitled to a ten day's free storage time to await the arrival of the ship. This storage time is under present conditions provided by the railroads handling the shipment from the interior.

From a careful investigation of the conditions governing the marketing of these various classes of cotton shipment in the port, it was found that the ratio of storage capacity to the amount of cotton handled annually was for Factor's cotton 1 to 2½, for F. O. B. cotton 1 to 5 and for Through cotton 1 to 10, or more. Applying these ratios to the total estimated quantities of each class of cotton, the storage capacity of the warehouses is as follows:

For Factor's cotton.....	160,000 bales
For F. O. B. cotton.....	80,000 bales
For Through cotton.....	120,000 bales

A total storage capacity of.....360,000 bales

Actually, however, in addition to the storage capacity of the warehouses, there will be available the large sorting yards and the two floors of the reinforced concrete wharf, which will make available the maximum storage capacity of approximately 500,000 bales.

The particular design of the warehouses which will afford this required storage capacity and which at the same time will satisfactorily meet all conditions governing the marketing of cotton and which could be erected for the least investment, was determined upon only after careful consideration of the various types of warehouses now in use.

At Memphis the warehouses of the Memphis Terminal Company are one-story in height and are so designed that ordinarily cotton is not tiered or piled. This plant with a storage capacity of approximately 200,000 bales, together with the terminal trackage and the yard space, occupies an area of one hundred and seventy acres of which the buildings alone occupy seventy acres.

The large multi-story warehouses of the New England cotton

mills are very economical in ground area, and while they provide for the storage of cotton so that piling or tiering is unnecessary, not only is the investment per bale of storage capacity very high, but the design and installation of an efficient mechanical handling and conveying system is very complicated.

In general, there is as much diversity in the design and construction of warehouses used for cotton storage abroad as in this country. The older types of warehouses in Liverpool, Manchester and Continental ports are of a type similar to our brick and wood construction, varying from four to ten stories in height. The only conveying machinery used in connection with such warehouses is the ordinary rope hoist or whip operated from an extension boom at the end of the building by which the cotton may be raised to any desired floor. The newer types of warehouse, particularly on the Continent, are of the single story type, where the cotton is piled or tiered from five to twelve bales high. The handling machinery in these warehouses in general consists of portable cranes or tiering machines. The one exception to the ordinary type of warehouses was found at Trafford Park near Manchester, England. This warehouse, which is composed of nine compartments, has a storage capacity of approximately 40,000 bales of cotton. Each compartment of the warehouse is 165 feet long, 35 feet wide and 45 feet high, built of reinforced concrete. In front of each compartment, at an elevation about midway between the floor and roof of the compartment and extending the full width of all compartments, is a receiving gallery on which cotton is landed as it is lifted from the railway cars, drays or barges for weighing before delivery into the warehouse department. There is an electric crane in each compartment which takes the cotton from the receiving gallery and delivers it into the compartment where the cotton is piled or tiered, bale on bale, as many as twenty bales high. The conditions of storage, however, at Manchester are such that it is not usual to require the delivery of any particular bale or cotton, but rather the delivery of certain lots. That is, the storage is for the consumer and not for the merchant, for which reason the cotton is not piled so as to readily secure any particular bale.

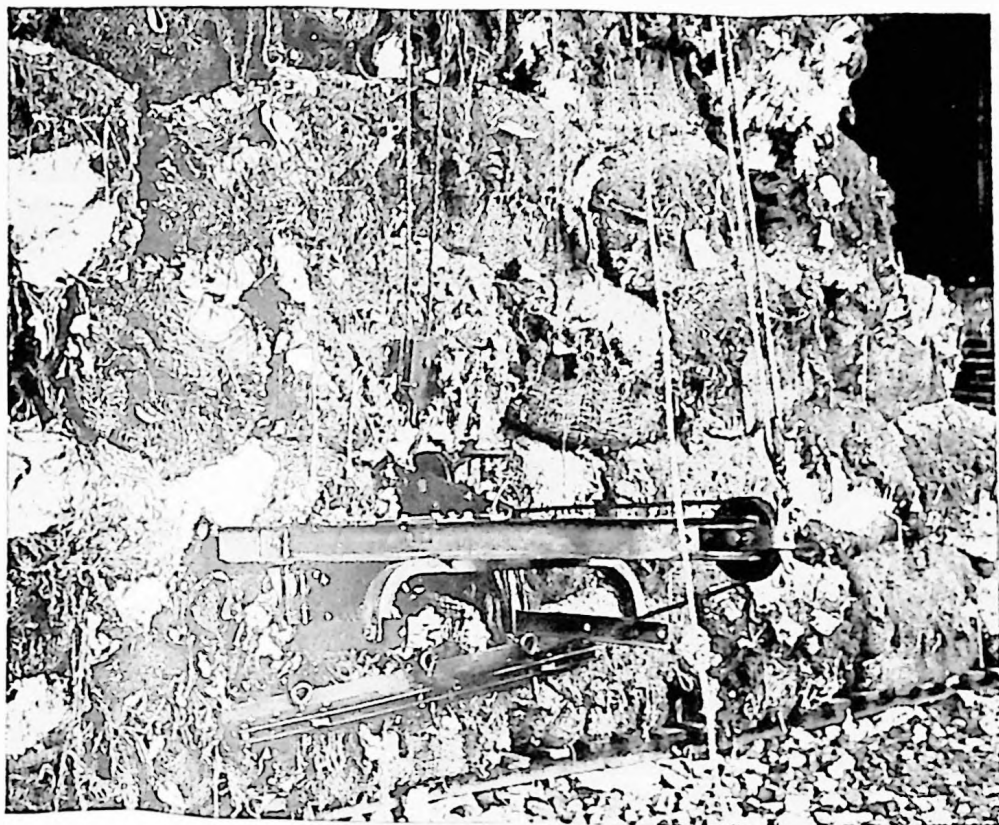
F. O. B. and Consigned cotton. On the south of these warehouses are further depressed railway tracks, while on the south of the tracks are located the two warehouses for Through cotton, which are proposed to be 676 feet long by 173 feet deep and divided into 21 compartments each 32 feet by 101 feet from center to center of walls. Between the warehouses for Through cotton and the wharf are railroad tracks which serve the south side of the Through warehouses and the north or rear side of the wharf. The wharf proper, exclusive of the receiving platform on the north side, is 120 feet wide on the first floor and 100 feet wide on the second floor with a total length of 2,000 feet. In front of the wharf and extending the full length is a creosoted pile apron wharf 44 feet wide on which are located two railroad tracks. The first floor of the wharf and apron is designed for a load of 500 pounds per square foot, while the second floor of the wharf is designed to carry 350 pounds per square foot. The wharf will be of reinforced concrete supported on untreated pine piles driven in clusters spaced 20 feet on centers each way. These piles will be cut off below low water, capped and reinforced concrete columns carried up to the first floor, which will be at an elevation of approximately 5 feet above the highest known water. On the apron wharf, in addition to the two railroad tracks, will be located the semi-gantry portable wharf cranes of both the derrick and continuous conveyor types.

The typical cross sections from the north face of the Compress building to the south face of the wharf very clearly illustrate the general features of design and the relation of each one of the units of the terminal with the other. It is planned that in the general operation of the terminal uncompressed cotton will be delivered on the north side of the Compress shed where the cotton will be tagged, sampled and weighed by the employees of the Port Commission, but under the general direction of the New Orleans Cotton Exchange. Uncompressed cotton will then be passed through the compressor after which it will be taken to the proper compartment by electric trains, from which the cotton will be lifted by the automatic grapple attached to the overhead electric travelling crane and placed in its proper position in the warehouse compartment. Cotton received at the

warehouse compressed will be switched on the railroad tracks directly to the proper compartment where it will be unloaded on the platform, then tagged, sampled and inspected. The electric crane in the compartment will lift the cotton with the grapple and store in its proper position.

In shipping cotton, the crane will first remove the bale from the compartment. If the bale is on top of the pile, the bale will be lifted by the automatic grapple, but if the bale is within the pile, the bale will be removed from the pile by the cotton puller and then lifted by the grapple and placed on the platform in front of the compartment. Here the cotton will be weighed and properly marked for shipment, then lifted on the electric train and carried directly to the wharf where it will be unloaded and later, by the use of the wharf cranes, placed in the hold of the ship. The upper photograph, Plate No. II, shows the cotton puller in position ready to remove a bale of cotton from the pile, while the lower one shows the same bale after it is removed by the puller.

The puller consists of a portable framework constructed of commercial shapes, adapted to be transported either by hand or by means of a travelling crane from which it is designed to be normally operated. In applying the apparatus to its intended use, the frame is supported from the overhead traveling crane which is moved to a position in front of the pile of bales from which it is desired to remove a particular bale. The frame is then lowered to the position just above the bale to be removed and so placed that the arms extending from the frame are forced in between or under the bales immediately above the one to be removed. The cable operating the puller is then drawn out and the two hooks are shoved through the pile on both sides of the bale to be removed until the lower ends of the hooks project beyond the other side of the pile and the hooks turn so as to cant the tines at the lower ends to engage the rear lower corners of the bale. The block and tackle on the end of the frame is then adjusted so as to maintain the frame in an approximately horizontal position, and the cable by which the frame has been previously supported is loosened by means of the clamp. The hoisting drum, which lowers the cable, is then operated to exert

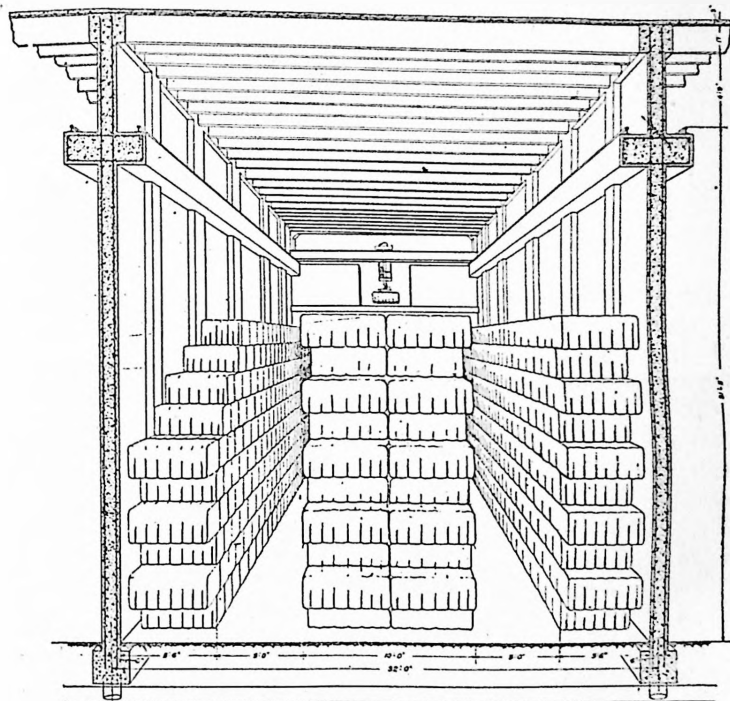


COTTON PULLER IN POSITION



BALE REMOVED BY PULLER

a lifting strain on the cable which has the effect of lifting the frame to a sufficient extent to cause the arms of the frame to lift the weight of the bales superposed on the bale to be removed and thereby relieve the vertical pressure on the latter to admit of the same being withdrawn. The pull on the cable also forces the frame firmly against the pile of bales, the continued pull result-



INTERIOR PERSPECTIVE OF COMPARTMENT

ing in the bodily movement which causes the yoke to move the hooks outwardly from the pile and thereby extract or withdraw the particular bale to which the hooks are attached. After the bale has been removed the tension on the cable is relieved and the apparatus permitted to swing free from the pile of bales so that it may be moved to any position for extracting another

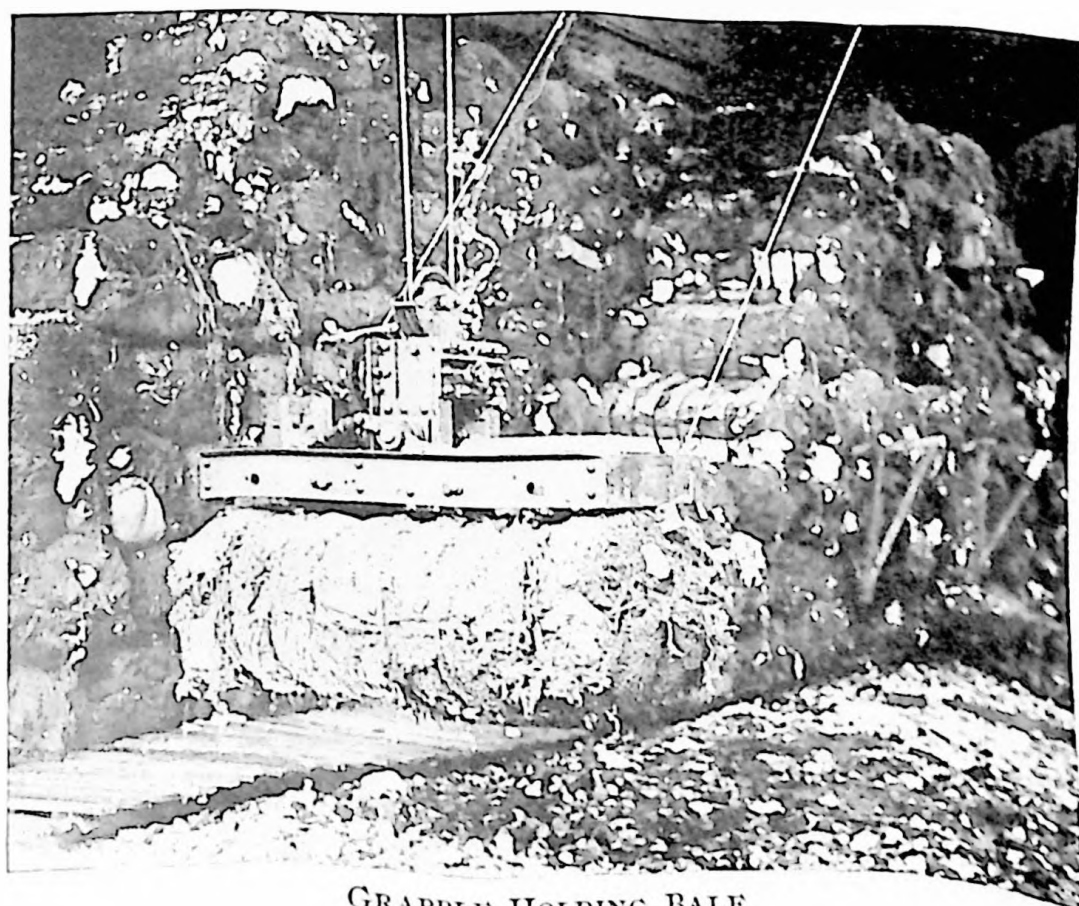
bale. Inasmuch as it is customary to stack the bales in staggered or bonded relation, the removal of the apparatus will permit the bales to settle down into their normal position without disturbing the relation of the individual bales of the pile or stack.

The entire operation of removing any particular bale from the pile may be accomplished within three minutes and requires the assistance of only one operator other than the crane operator stationed in the cage on the trolley of the crane. It is, of course, necessary in using this puller that the cotton be piled in rows with aisles of sufficient width to accommodate the length of the bale. The method of piling cotton is clearly illustrated in the view showing the interior perspective of one of the compartments.

The operation of the automatic grapple is shown by Plate No. III. This entire apparatus is supported by means of the cable from the overhead crane in the same manner in which the cotton puller is supported. This allows of the grapple being not only transported from place to place by the crane, but it may be also raised and lowered at the will of the operator. The grapple is so designed as to perform the entire operation of moving, lifting, lowering and stacking the bales without the necessity of the bales being handled by laborers in any way whatever. Whenever it is necessary to lift a bale and transport the same from one place to another the grapple is lowered or placed by the operator in the crane immediately overlying the bale. The operator on the crane then closes a switch which controls the motor driving the operating mechanism of the grapple. This motor rotates a shaft which moves the rocker arms and links connected thereto so as to swing the bell crank levers downward thereby forcing the tines through the upper surface of the bale and into the body of the material on opposite sides of the frame. After the bale has been thus firmly gripped by the tines of the grapple it can be lifted by means of the cable and transported by the traveling crane, to which the cable is attached, to any place where it is desired to deposit the bale. After the bale has been placed in position the operator again closes the switch controlling the circuit to the motor to reverse the direction of the current in the latter which effects a reversal of the movement of the gears in the worm shaft. This reverse movement



GRAPPLE ABOVE COTTON BALE



GRAPPLE HOLDING BALE

the declaration of the ship's agent as to the date of sailing and is ordinarily allowed a certain free storage time for this purpose. At the expiration of this time, it is delivered by the railroad to the wharves to await the arrival of the ship.

The warehouses were designed to meet the conditions of marketing and shipping cotton with as little modification of present methods as practical. Except for the increased space occupied by the flat or uncompressed bale, such cotton can be as economically handled, stored and transported in the warehouse as the compressed bale. In order to reduce the cost and to avoid unnecessary movement, it is proposed that the handling of cotton in the warehouses will be as follows:

Factor's cotton, if received by rail, will be delivered directly to the Compress, where, as it is unloaded from the cars, it will be ranged for sampling, which will be done under the direct supervision of the Sampling and Inspection Bureau of the New Orleans Cotton Exchange. After sampling, the flat cotton will be compressed, from the Compress being loaded on the electric trains and transported to the proper compartment where it will be lifted from the train by the grapple and conveyed to storage by the electric crane. When ordered shipped it will be removed from the compartment by the crane and after weighing and marking placed on the electric train and transported to the wharf.

F. O. B. cotton will usually be switched in the railroad cars directly to the compartment for which it is intended, will be unloaded from cars and after inspecting and sampling will be handled directly into the compartment. When ordered shipped, the same routine will be followed as for Factor's cotton.

Through cotton, if the ship is in port, will be delivered directly to the wharf and may be unloaded directly from cars to ship, or if the ship is expected within a reasonable time, unloaded from cars to wharf, while if the ship is not expected, unloaded from cars to compartments provided for this purpose where the cotton is handled by electric cranes and grapples, but stored in bulk without reference

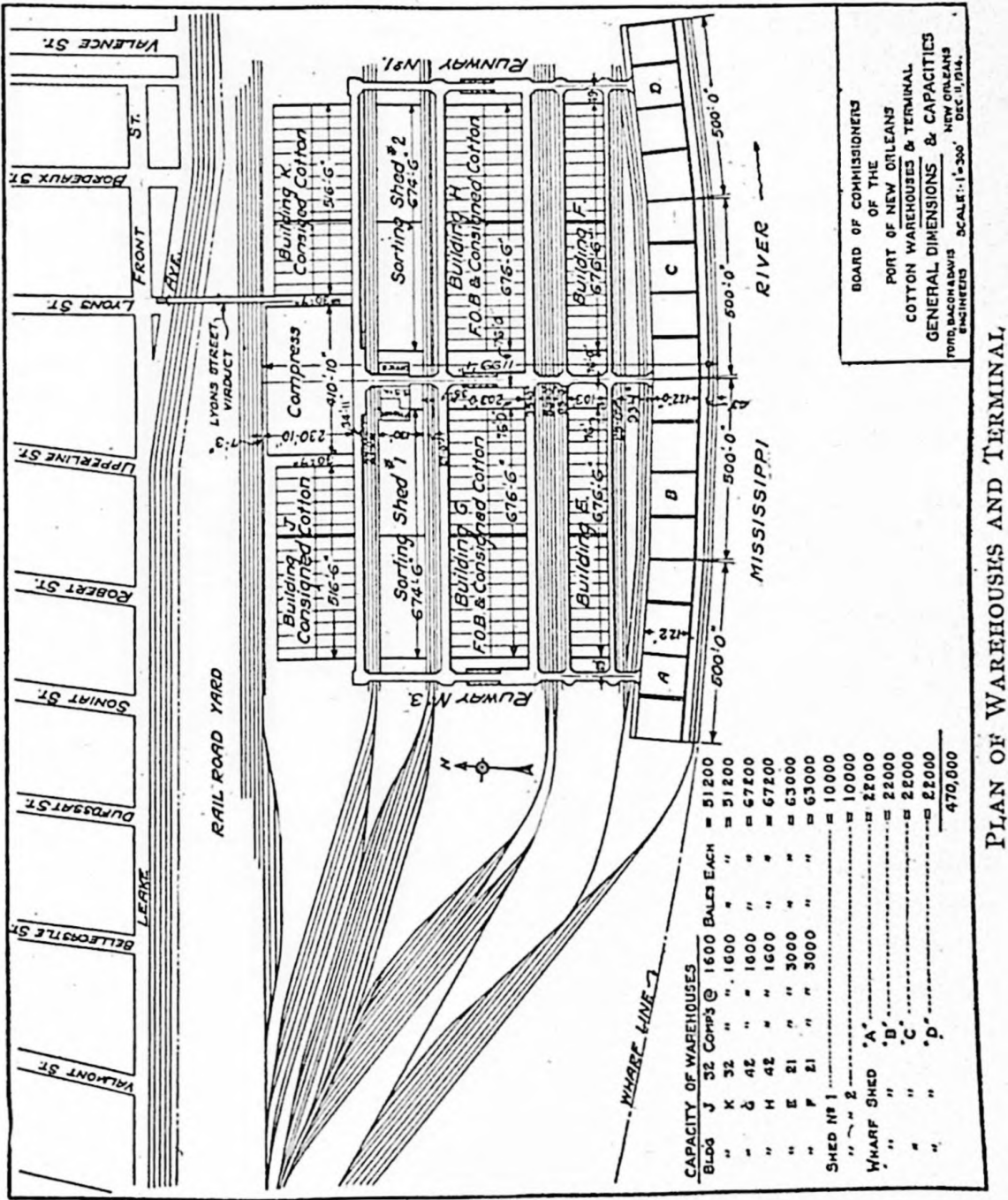
to aisle spaces. This is possible because in handling Through cotton, it is not necessary to handle the individual bale.

How far the cotton warehouses and terminal may affect the development of the Port of New Orleans as a deposit market for cotton, it is extremely difficult to predict. The construction costs of the terminal have been kept at a minimum consistent with conditions of service to be fulfilled. The most efficient mechanical handling and transporting equipment has been installed and operating cost should show a material reduction, while from a financial standpoint it is proposed to develop a system of inspecting, handling and classing of cotton, which will enable a certified receipt to be issued for the cotton by the State of Louisiana which will represent the highest class of bankable paper. The total charges for handling, storage, transportation and insurance should, therefore, at least equal such charges at other ports of the world, and a financial system which would provide adequate funds at reasonable interest rates, should make the Cotton Warehouses and Terminal an important factor in making the port a deposit market. The development, however, particularly as to the advantage of New Orleans for receiving, holding and distributing commodities, depends largely upon the question of ocean, port, river and rail rates. The cotton warehouses and terminal can only affect the development in so far as it can economically render the services for which it was designed.

In developing a system of warehouses for the port of New Orleans, the Board has prepared the way for the future growth of the port not only in additional facilities which will directly affect its ability to increase its commerce, but along broad economic lines, which should enable New Orleans to become not only a great port in the sense of a land and water terminal, where goods are transferred from one system of transportation to another, but a great port of trade where the products of the world may be bought and sold.

New Orleans as a port is administered as a State public utility where the charges of the port are such as to produce only sufficient revenue to meet all operating expenses and fixed

charges with a minimum surplus for contingencies as distinguished either from the privately owned terminal controlled by steamship lines and trunk line railway systems where the charges are fixed by the transportation companies and absorbed



in the general freight rates, or as in the ports of foreign States and municipalities where the charges are not sufficient to produce an adequate revenue for the operation and maintenance of the port, but are supplemented by a general tax levy of the

State or Municipality. The State of Louisiana by its established policy of government ownership and control of harbor facilities has already made available, not only for the people of New Orleans and Louisiana, but for the entire Mississippi Valley, a port which to-day ranks among the first of the United States in equipment, and the completion of the cotton warehouses and terminal marks a greater advance in State control than has been experienced by any other American port.

As has been indicated and as shown on the general plan, the terminal buildings and trackage adjacent to the plant occupy an area of approximately sixty acres or a space 2,000 feet parallel to the river with a depth of 1,400 feet from the outer edge of the wharf to Leake Avenue. The main entrance to the plant is at Lyons street with a foot bridge for crossing the tracks on Leake Avenue and the yard tracks of the Public Belt Railroad within the property.

In the center of the property on the North or Leake Avenue side, is located the Compress building. Within this building there will be three standard compresses with arrangements for additional compresses capable of producing the so-called high density bale. The Compress building is 410 parallel to Leake Avenue by 230 feet. On each side of the Compress, but separated from it by passage ways 30 feet 7 inches wide, are the two warehouses J and K for Consigned cotton. Each of these warehouses occupies a space 516 feet parallel to Leake Avenue by 270 feet deep and is divided into 32 compartments each 32 feet by 100 feet 6 inches from center to center of walls. South of the Consigned warehouses are the large sorting platforms, each 674 feet by 130 feet. On each side of these platforms there are two railroad tracks depressed so that the car floor will be level with the floor of the platform or of the warehouses on the opposite side of the tracks. In the center of the plant, and at the end and the approximate center of the sorting platforms, are located the office or administration building and the central power station. South of the sorting platforms are the two warehouses G and H, each of which occupies a space 676 feet by 273 feet, divided into 42 compartments 32 feet by 100 feet, 6 inches from center to center of walls. These warehouses are for the storage of both

swings the bell cranks in a direction to withdraw the tines from the bale until the tines lie substantially within the frame of the grapple thereby completely releasing the bale from the grapple and leaving the grapple in condition to engage another bale.

The operation of the grapple is extremely rapid and the crane operator can by means of the grapple handle from 75 to 125 bales of cotton in an hour, lifting the cotton from its position on the gallery and placing it in the pile within the compartment.

It is expected that, due to the general design of the warehouses and terminal and to the use of the mechanical appliances in piling, unpling and transporting the cotton, the cost of handling will be reduced approximately forty per cent. below the present cost. As has been previously stated,, New Orleans is located 225 miles from the center of the cotton production of the United States. The outline area on page 135 shows the relation of New Orleans to the cotton producing center as well as the relation of other Gulf and Atlantic ports to this center. The map on page 132 shows the cotton producing area of the world. Of the total the United States produces approximately two-thirds of the cotton of the world. New Orleans possesses, therefore, every advantage of position, both in reference to the center of production of the raw material and in its relation to the ocean routes of commerce so that its importance, both as a cotton market and as a cotton port must depend upon the facilities provided for the marketing, transporting and transshipment of cotton and the energy of its citizens in using such facilities to the utmost.

Discussion Upon "Cotton Warehouses and Terminal for Port of New Orleans."

THE CHAIRMAN: You have heard the very interesting paper of Mr. von Phul and I am sure we all enjoyed it. I will entertain a motion to give Mr. von Phul a rising vote of thanks for the entertainment he has given us to-night.

The motion to give Mr. von Phul a rising vote of thanks was made and unanimously carried.

THE CHAIRMAN: Mr. von Phul, it is customary to have the

members ask a few questions, and if you care to have them ask any—

MR. VON PHUL: Yes sir, I will be very glad to have them do so, and if I can answer them, I will be glad to do so.

THE CHAIRMAN: If there are any questions you would like to ask Mr. von Phul, gentlemen, he will be glad to answer them.

MR. SHAW: I would like to ask Mr. von Phul in regard to the handling of those overhead cranes. Is it expected that they will transfer cotton from one compartment to another, or are they simply arranged so that you can get the crane from one compartment, using the electric train for transferring the cotton along the gallery.

MR. VON PHUL: The transferring of the cotton either from compartment to compartment, or from compartment to the wharf, should be done by the electric train.

MR. SHAW: This transfer of crane from compartment to compartment will simply be for economy of machine equipment and will not be a regular operation?

MR. VON PHUL: Each compartment will not necessarily have its own cranes.

THE CHAIRMAN: I will say, gentlemen, that I had the opportunity of going through that work the other day at the wharf, and I was surprised at the moment of work that was going on out there. I understand it is to be finished the first of August.

MR. VON PHUL: The first two units will be finished the first of August, and the other two units the first of October.

MR. GREGORY: I would like to ask Mr. von Phul if the devices he showed us for taking out a bale from the bottom of a pile, are an invention of his, or Ford, Bacon & Davis, or if they were devices adopted or approved.

MR. VON PHUL: The development of the devices was in our office entirely. The office organization worked it up.

MR. SIMMONS: On the same subject, I didn't quite catch that scheme. How are those hooks gotten through the other side, if one bale is at the bottom, and the other is piled around to where the hooks are shoved through from the other side, and then hooked?

MR. VON PHUL: They are hooked from the front, but there

is invariably room to shove the hook through. There are various types of hooks to go through; there is one with a screw to screw it out from the end; there is always room in the pile of cotton to allow of that operation.

MR. SHAW: In regard to getting a bale from the bottom or center of a pile, the explanation given by Mr. von Phul should be noted that there is a lifting action in the operation of the jack which at least partially overcomes the frictional resistance and makes it possible to extract a bale without exerting a pull on the hooks which would tear the bale open.

MR. VON PHUL: The lifting action is applied at the front, while the bale is delivered by the pull applied on the rear end of the bale.

MR. SHAW: It would not be a dead pull against the position of the surrounding bales?

MR. VON PHUL: No, both a lifting up and pulling forward at the same time.

THE CHAIRMAN: Mr. von Phul, is it contemplated to go right ahead with the Three Million Dollars worth of work?

MR. VON PHUL: Yes sir; already contracts—for a million and a half dollars worth of the work have been let, and the next contract, which will close up the work, will be let within sixty days. The entire work will all go right on.

THE CHAIRMAN: Are there any other questions, gentlemen?

MR. SCHWAB: Will there be more than one crane for each warehouse, or will there be one crane for each compartment, and if there will be one for each warehouse, how will it go from one compartment to the other?

MR. VON PHUL: There are seventy-four compartments and it is planned to install about forty cranes. There will be a transfer table to move the cranes from each compartment into any other compartment.

MR. SCHWAB: Will the operator ride with the crane?

MR. VON PHUL: Not necessarily. There is no advantage in it; he will simply run the crane.

MR. SCHWAB: But I meant when he is handling the cotton, does he ride?

MR. VON PHUL: Oh, all the time, yes sir. The operator's

cage is on the trolley and not on the bridge, so that the operator travels with the trolley.

MR. SCHWAB: Is this pulling apparatus part of the crane?

MR. VON PHUL: No, independent.

MR. SCHWAB: And rides on the same rails?

MR. VON PHUL: Not so; it does not ride on the rails at all. The pulling apparatus is just a small "A" frame, about five feet from the apex to the base, and is moved around by hand, as it only weighs a couple of hundred pounds.

MR. SCHWAB: It comes from above through the crane. The crane operates the pulling device?

MR. VON PHUL: Yes-sir, it operates the pulling device.

THE CHAIRMAN: Any further questions, gentlemen? If not, or if there is no further discussion on this paper, we can close our meeting, and we have something outside that will help us all a little.

MR. BURWELL: I would like to ask one question, and that is in regard to the good deal of work that is done by lighters. Nothing was said about it.

MR. VON PHUL: Well, except in this way, that the cotton can be loaded direct from the ship to the lighter, just as readily as from a ship to the wharf, and probably a lighterage system will be established.

MR. BURWELL: The ship will transfer?

MR. VON PHUL: No, it can be transferred direct from the wharf to the lighter, or from the lighter to the wharf and while the lighterage system is not necessarily a part of the cotton terminal, provision has been made to operate the terminal in connection with the lighterage system, should the opportunity to install it develop.

MR. SCHWAB: Would there be any advantage in a lighterage system, except for a mixed cargo, to obviate the necessity of a vessel moving from one wharf to another?

MR. VON PHUL: If a few hundred bales of cotton were lying at some other wharf, and could be loaded on a lighter, and loaded from the river side while the ship is at the same time working from the other side, it is surely considered to be an economic way of handling.

MR. SCHWAB: That's the idea of a lighter?

MR. VON PHUL: That's the idea of a lighter.

THE CHAIRMAN: I understand, Mr. von Phul, that Ford, Bacon & Davis have gotten the contract to open Galveston; is that anything as large as over here in New Orleans?

MR. VON PHUL: The size of the wharf is possibly the same as the wharf here. The area is almost identical.

THE CHAIRMAN: And do they contemplate spending as much money?

MR. VON PHUL: No sir, not as much.

MR. SCHWAB: Will the new wharf be finished at the time the first units are completed?

MR. VON PHUL: No; it cannot be constructed until after—during low water.

THE CHAIRMAN: Where is that, in Galveston?

MR. SCHWAB: Here.

THE CHAIRMAN: Any railroad men here, any steam railroad men here, who want to ask any questions about the terminals? May I ask if Mr. Arnold is coming down?

MR. VON PHUL: I don't know, Mr. Datz. That is a matter for the Belt Railroad. I don't know anything about it.

A SUGGESTION FOR HANDLING FREIGHT ON INTERIOR WATERWAYS.

By

H. L. HUTSON.

(Read before the Society, October 12, 1914.)

The low cost of transporting freight by water is well known. The chief expense comes at the two ends of the haul in the cost of loading and unloading, and often the cost of transporting the freight a few miles by wagon will exceed the freight charges.

To reduce the cost of loading and unloading from barges and ships is a problem which has had a great deal of study by engineers better able to design machinery for the work than I and therefore I do not intend to advocate any novel system of handling freight but to call attention to a scheme to adopt devices in common use to handling a variety of freight.

If we study the means for loading freight, we can divide them into two general classes: 1st, those in which the load rests on the carriers; 2nd, those in which the load is hoisted and hangs from the carriers.

As example of the first, we have loads carried on hand trucks and various carriers (such as belt conveyors) suited for special classes of freight. Although the hand truck is suited for and used on a great variety of freight, as soon as an attempt is made to design a conveyor of this first class to carry large tonnage, it at once becomes either excessively heavy and expensive, or else is suited only for one class of freight.

In the second class, we have the cargo derricks of sea-going ships and all classes of dock cranes, mono-rail systems, cableways, dipper dredges, etc.

It would seem that the chance of developing a system suited to all freights is best if we consider that the freight is to be hoisted to and from the vessel.

Let us see some points to be borne in mind in selecting equipment for this purpose:

1st. The container in which freight is shipped must suit the freight: Thus, liquids in barrels or tanks; vege-

tables in open ventilated crates; grain in sacks or closed boxes; perishable food in iced boxes.

2nd. The method of attachment between hoist and load must suit the container or the load: Thus, rope slings, chain slings, timber hooks, electro magnets, etc.

3rd. The type of vessel must be such that the load can be lowered either into her hold, or onto the deck.

4th. The type of hoisting and handling machine must be suited to the location and service: Thus, in one place a stiff legged derrick with hand power; in another, a locomotive crane; in another, a very complicated overhead mono-rail system.

Note—That for all the classes of freight and all locations, there is but one thing which must remain the same and that is that the load is hoisted from above and so landed where it is wanted.

Let us now look around for certain classes of freight which are cheaply handled and try to adopt the same methods for other classes or for miscellaneous freight. On the New Basin, we find sand and shell brought in as deck loads on barges and unloaded by locomotive cranes or special derricks equipped with clam shell buckets. On the Lake Borgne Canal coal is brought in from Alabama as deck loads on the decks of Mr. Bernhard's self-propelled steel barges and unloaded by clam shell buckets operated from special coal handling towers.

On Bayou Lafourche and the Teche, we find the sugar planter handling cane at a very small cost per ton. This cane is loaded in the field into carts across which chains have been laid and thus carried to the Bayou, where the cane is hoisted a wagon load at a time, into barges from which it is again hoisted upon arrival at the sugar house or the point where it is transferred to cars.

If we come back to the New Basin, we find another case of freight being handled in wagon load lots. Brick are brought in on barges or schooners, the bricks being crated in rough crates holding, I suppose, a thousand bricks. Each crate is picked up by a derrick and set on the ground or stacked on top of other

crates ready to be lifted again when the time comes to load it on the wagon.

I believe we should adopt this scheme of the Salmen Brick and Lumber Company with slight modifications to form a standard system for handling local freight at least.

There are several reasons why it would cost very little to try this out on certain local water routes. Anyone familiar with the river will tell us that the part of the river front which was formerly used by river steamers is now mostly used only by gas boats of one sort or another. These boats operate very cheaply as the crews are small and if they could load and unload their freight by mechanical means, a crew of the same size could manage a barge of many times the size.

Again, there are a great number of barges throughout the sugar district which lie idle a great part of the year and could be used in connection with steam or gas tow boats.

Throughout the sugar district, every landing has a derrick even when it has no wharf. The only thing needed therefore to put such a system into use between New Orleans and points on Bayou Teche would be:

1st. For the Dock Board to install a locomotive crane, derrick, or some other type of hoist on the docks for the use of these local freight carriers.

2nd. For some company to own and supply for use when needed various kinds of boxes, crates, tanks and other receptacles, each designed to hold one wagon load—say two tons maximum.

The first of these conditions will no doubt be met when the demand is great enough.

The chief obstacle in the way of the second is that what is anybody's business is nobody's business.

Before going farther, let us look back and consider some of the causes of the decline of water-borne freight in favor of rail freight.

The principal reason is undoubtedly that the railroads can serve the country at large better than the waterways, but there are certain places where it is possible for the water transportation companies to carry freight cheaper and quicker and gener-

ally give better service than the railroads. Yet, even in these cases, the railroads get the bulk of the freight due to a better selling organization.

Every railroad agent in each small town is a selling agent not only for his own line, but for connecting lines. In addition to this, the railroads have well organized soliciting departments. In spite of this, the railroads themselves have not given the best service possible, and the higher class of business open to them, the cream of the business has gone to other companies organized to do business over their lines. I refer to the Express Companies, the Pullman Company and the Refrigerator Car and Tank Car lines.

The fact that these companies have found it both possible and profitable to furnish special equipment and special service for carrying on business over the lines of another company make me believe that a successful concern could be organized to furnish the boxes or other special containers to permit handling of freight in wagon load lots.

The chief need, therefore, is for someone who is a monopolist and organizer by nature to take the thing in hand. Let us look ahead a few years and suppose that Armour or someone else has organized such a corporation and that it is in full working order. This company, we will say, owns equipment for holding every class of freight and in addition has a pick-up and delivery service in the larger towns, with auto trucks of standard design—each equipped to load on to itself a box weighing two tons. The company will also have a large freight shed with sorting conveyors and overhead cranes. We will call it—

The People's Despatch.

We will suppose a wholesale merchant gets a hurry order from a country customer for an assorted list of groceries. We will phone the Despatch Company for an empty which will be dropped at his store early in the morning. The merchant, instead of spending a lot of time boxing and crating his stuff in separate crates, will merely load it securely in the wagon box which in this case must be weather proof, and when the Despatch Company's truck returns later, it will be sealed and hoisted on to the truck and carried to the dock.

Here it will be picked up by locomotive crane and placed on the dock of the first freight boat leaving for the landing to which it is consigned. This boat may have a crew of pilot and engineer only and yet they will be able to unload this wagon box load—of we will say one ton—provided the landing is equipped with a derrick. If the landing were a private one, it would be expected that the consignee would bring his own wagon and haul to his store. If it was a town of some size, the Despatch Company would undoubtedly maintain a delivery service.

If such a company were organized, I would not want to see it a subsidiary of water transportation lines necessarily as one of its chief functions would be to co-ordinate the rail and water transportation as well as the road and water transportation.

At present, the cheapest and quickest way of unloading material from rail to water is the way coal and ore are handled, by tipping the car over into a bin.

With this wagon load system, the boxes or crates of merchandise would be lifted from a flat car and deposited on the deck of a barge or vice versa.

Thus, a farmer could load watermelons (we will say) in his field into a "wagon-crate," seal and lock this and carry it by wagon to his private landing. The barge line would stop alongside long enough to lift these on deck and carry them to the nearest through railroad switch where they would be lifted either directly from barge to flat cars or in more frequent cases the transfer would be made from barge to auto trucks and from these to cars.

With the increased mileage of good roads and the use of auto trucks in the country which is sure to follow, it will be possible for districts 30 to 50 miles from a river to utilize the waterway provided the freight can be cheaply transported by wagon train and loaded without rehandling.

Let us take the rice crop for instance. Most of this crop is raised on land watered from a navigable stream, yet a very small part of the crop moves by water. I know one canal in which part of the crop is barged to the pumping plant in small canal boats and transferred by hand to tide water boats, but this is an exception. With such a system of wagon boxes as I advo-

cate, it would be possible to load the rice in the field into boxes which would protect it from the weather at once. These boxes could be carried on mule-drawn wagon while in the field, but when they reached a paved roadway, a number of boxes would be placed on heavy wagons to form a wagon train of perhaps ten wagons, which would be pulled by traction engine to the nearest river landing.

Again, let us take a case where two waterways are near together, but do not connect for some reason, such as difference in water level, or expense of making the connection. As an illustration, we will take the Mississippi river and the two navigation basins in New Orleans, or the Lafourche at Donaldsonville. If freight were brought down the river say from Minneapolis and one or two of the boxes were consigned to a merchant at Slidell, it would be an easy matter to pick up these particular wagon loads and carry them by truck to the New Basin, where they could be picked up by Mr. Salmen's derrick and placed on one of the barges which bring over the crates of bricks. In the same way, a crate of bricks could be carried across town and delivered by Harvey's Canal to a shell road leading into the newly reclaimed plant of the Plaquemine and Jefferson Drainage District.

Heretofore, I have advocated that the wagon box be picked up by being hoisted from above and the objection may be made that one of these boxes would be too cumbersome to move about a warehouse, where there were no overhead facilities. This worried me at one time, but I find there are several elevating hand trucks on the market which can pick up a load of this size, provided there is six or eight inches under the load so that the trucks may be run under the load. These hand trucks could be used to shift loads about the deck of a barge to trim the vessel or when the derrick could not place load properly.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Board of Direction, April 12, 1915.

The meeting was called to order with President Datz in the chair, Messrs. Coleman, Gregory, Dusenbury, Olsen and Hogg were present.

Minutes of the last meeting were read and approved.

A communication from Mrs. Edward Wisner expressing her appreciation of the Resolutions of the Society on the death of Mr. Wisner was read and accepted. The resignation of Mr. Walter Moses held over from last meeting was cancelled, as Mr. Moses had expressed his wish to remain in the Society. The resignation of Mr. H. J. Schmitz, student member, was accepted. The resignation of Mr. S. L. Menge was refused, as Mr. Menge is a resident member, and his resignation could not be accepted before the end of the current year.

Communications from Trautwine Co., McGraw-Hill Book Co., John Wiley & Sons, Inc., addressed to Mr. R. H. Baumbach, were read. They stated that they were unable to place advertisements in our *Proceedings* at present. Mr. Trautwine expressed his regret that we had withdrawn from the Association of Engineering Societies.

Communications from Ohio Society of Mechanical, Electrical and Steam Engineers, Engineers' Club of Toronto, Rochester Engineering Society, Engineers' Society of Pennsylvania, Pacific Northwest Society of Engineers were read and accepted. The communications complimented us on our new *Proceedings*, and offered their *Proceedings* in exchange.

Ballots for the election of members were opened. There were 52 formal and 4 informal ballots. The following were unanimously elected:

Resident Members—Matthew Scott Sloan, 1306 Octavia street, New Orleans; Samuel J. Dill, 201 Baronne street, New Orleans; Eugene F. Delery, 503 City Hall Annex, New Orleans; Robert John Titzel, 201 Baronne street, New Orleans, Virgil A. Eberly, 4025 Prytania street, New Orleans; Arthur M. Scott, 823 Perdido street, New Orleans; H. P. Porter, 4421 Laurel street, New Orleans.

Transfer from Non-Resident Junior, to Non-Resident Member—Fred N. Shutts, P. O. Box 610, Lake Charles, La.

Transfer from Student to Junior Membership—Herbert P. Nathan, 3004 Prytania street, New Orleans.

Associate Membership—Roger Bradshaw Quiney, 1022 Hibernia Bank Building, New Orleans.

A number of applications for membership were ordered to ballot, subject to the approval of the Membership Committee.

The following bills were approved for payment:

L. C. Datz (stenographer's fee, March meeting).....	\$15.00
Searey & Pfaff, Ltd. (binding 38 volumes).....	47.50
J. Buckley & Co., Ltd. (engraving for <i>Proceedings</i>).....	5.00
F. Daubert (refreshments March meeting).....	10.50
Electric Railway Journal (subscription).....	3.00
Tulane University Press (stationery).....	13.25
W. T. Hogg (salary and incidentals).....	24.80

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Society, April 12, 1915.

The meeting was called to order with President Datz in the chair, and 55 members and guests present.

Minutes of the last meeting were read and approved.

A communication from Mrs. Edward Wisner expressing her appreciation of the Resolutions of the Society on the death of Mr. Wisner was read and accepted. The list of new members elected at the meeting of the Board was read.

The technical exercises of the evening were then held. Mr. Wm. von Phul read a very interesting paper entitled, "Economic Features Controlling the Design of the Cotton Warehouse and Terminal of the State of Louisiana for the Board of Commissioners of the Port of New Orleans." The paper was followed by a brief discussion.

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Board of Direction, May 10, 1915.

The meeting was called to order with President Datz in the chair. Messrs. Coleman, Gregory, Olsen, Williams, Young and Hogg were present.

Minutes of the last meeting were read and approved.

A resolution declaring that \$2.00 from the annual membership dues of every member be appropriated to the *Proceedings* fund as a subscription price was moved, seconded and carried.

It was moved, seconded and carried that the President be authorized to ascertain the cost of auditing the books of the Society and report at the next meeting.

Ballots for the election of new members were opened. There were 51 ballots, of which 1 was informal. The following were unanimously elected:

Resident Members—Harry L. Villere, 1354 St. Bernard avenue, New Orleans; John A. Silsbee, 3923 Carondelet street, New Orleans; Harry L. McLean, 241 South Solomon street, New Orleans; Harold H. Gibson, 236 Olivier street, New Orleans.

Non-Resident Members—Frederick H. Frankland, Lake Charles, La.; H. F. McDermott, 1880 Continental Commercial Building, Chicago.

Junior Members—James J. Bulliung, 2822 Louisiana avenue, New Orleans; Frank L. Holt, 2730 Myrtle street, New Orleans.

Associate Members—Edwin Clinton Brown, 4215 Locust street, Kansas City, Mo.

The financial report of the Secretary was read and accepted.

The following bills were approved for payment:

Tulane University Press (stationery, printing).....	\$ 24.10
Tulane University Press (April <i>Proceedings</i> —if correct).....	120.30
F. Daubert (refreshments April meeting).....	10.50
W. T. Hogg, Secretary (salary, incidentals).....	21.80

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Society, May 10, 1915.

The meeting was called to order with President Datz in the chair, and 35 members and guests present.

Minutes of the last meeting were read and approved.

A report from the Library Committee was read. The committee reported that seven new books and the *Proceedings* of four national societies 1910 to date were ordered during the month. The committee also submitted a list of rules for the approval of the Society regulating the withdrawal of books from the library. The rules were unanimously adopted by the Society.

A communication from Mr. J. P. Kemper was read. Mr. Kemper expressed his desire to read a paper advocating spillways as a means of flood relief for the lower Mississippi. The communication was referred to

the program committee. A paper from Mr. Frederick H. Frankland, a non-resident member, was referred to the program committee.

It was moved, seconded and carried that the President be authorized to appoint an Outing Committee to report on the advisability and feasibility of giving an outing. The committee to report at the next regular meeting.

The technical exercises of the evening were then held. Mr. Charles M. Kerr read a very interesting paper entitled, "The State Highways of Louisiana." The paper was followed by an interesting discussion. Mr. Kerr was tendered a vote of thanks by the Society.

There being no further business, the meeting adjourned to the collation.

W. T. HOGG, Secretary.

PROCEEDINGS
— OF THE —
LOUISIANA ENGINEERING SOCIETY

VOL. I

AUGUST, 1915

No. 4

CONTENTS

EDITORIAL NOTES AND COMMENT:

	PAGE
Good Roads.....	167
Problems of the Contractor.....	170
Compensation of Engineers.....	171
Extra Copies of the Proceedings.....	174
Material for the Proceedings.....	174

BOOK REVIEWS	176
--------------------	-----

PAPERS AND DISCUSSIONS:

Louisiana State Highways. <i>By C. M. Kerr</i>	178
Discussion	197
Contractors' Organization and Equipment. <i>By Hampton Reynolds</i>	205

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY	209
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DIRECTORY OF OFFICERS.

L. C. DATZ, President, 201 Baronne Street.
SAMUEL YOUNG, Vice-President, 1002 Perrin Building.
E. H. COLEMAN, Treasurer, 920 Hibernia Building.
W. T. HOGG, Secretary, Tulane University, P. O. Station 20.

DIRECTORS.

W. H. WILLIAMS, 1016 Hibernia Building.
W. B. GREGORY, Tulane University of Louisiana.
A. T. DUSENBURY, 901 Maison Blanche Building.
OLE K. OLSEN, 823 Perdido Street.

The headquarters of the Society are in the State Museum
Building, Jackson Square.

Address all business communications to W. T. Hogg, Secretary,
P. O. Station 20, New Orleans, La.

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EDITORIAL NOTES AND COMMENT

Good Roads.—Mr. Kerr's paper, entitled "Louisiana State Highways," forms a valuable contribution to the records of this Society, for it traces for us the origin and development of the State Highway Department, and gives us a very interesting and instructive survey of the work it has set itself to do in the matter of, as Mr. Kerr aptly expresses it, "lifting Louisiana out of the mud." The paper does not deal with the many different methods of road construction and the technology of the subject, but deals with the more general question of the several methods by which State aid is extended to the parishes in order to enable them to handle the financial problem in the most economical way, and at the same time to supply competent technical supervision in the design and construction of its highways.

The original plan for a system of State highways as adopted by the department involved the building of a sort of "belt" road to encircle the State, starting at New Orleans and passing generally through the cities of Baton Rouge, Alexandria, Monroe, Shreveport, Lake Charles, New Iberia, Morgan City, and thence back to New Orleans. In view of the fact that such a system of highways as this would pass through only 50% of the parishes in the State, it was decided to change the plan to one by which a road would be built, in as straight a route as practicable, to connect the parish seat of each parish with that of each of the surrounding parishes. This is the plan which is being followed now in a general way in the operations

of the State Highway Department. It is interesting to note that the main lines alone of this latter system will measure up to some 4,000 or 5,000 miles of road.

The author of the paper argues very strongly in favor of the State convict as being the most economical and most easily handled form of labor in the building of these highways. It is pointed out that a saving of from 40 to 60 per cent in the cost of construction may be effected by the use of convicts in comparison with any other available form of labor. These statements are borne out by the statistics in the case. Of a total of 154.98 miles of various types of highway constructed with convict labor the average cost per mile was \$986.67; while of a total of 273.17 miles constructed by contract labor, the cost per mile averaged \$2,589.90.

While the primary object of any system of State highways is to furnish the citizens of the particular State with a safe and economical method of transporting their products to the nearest market or to the nearest shipping point, it must be remembered, as is pointed out in the paper, that these roads have their part to play in the social development of the communities which they serve. One of the most hopeful signs of the times is the beginning of a movement on the part of city people to get back to the country, and the rapid development of good roads in this country is not only a result of this "back to the soil" movement, but in many cases a forerunner or direct cause of it. It is recognized, of course, that the automobile has been one of the greatest factors in lessening the hardships and adding to the pleasures of life in the country. Where the automobile goes, good roads must follow. And in a consideration of the advantages of good roads from the standpoint of pleasure, one must think not only of himself, but as well of the "stranger within his gates." By this it is intended to argue that in any general plan for a system of State highways provision should be made for well-built roads over which the tourist would be able to reach easily the more important portions of the State, such, for instance, as the larger towns and cities, and typical localities such as the Teche country, with its sugar and rice plantations. One is reminded forcibly

of this need by the lack of any decent road over which a visitor from another State might come into the City of New Orleans. It is a matter of common observation, however, that the nearer one gets to a town the poorer become the roads, doubtless due to some lack of proper coöperation between the parish and the municipal road authorities.

A serious factor in the construction of good highways in the State of Louisiana is the fact that on the average there is so little good surfacing material near the locality in which the roads are under construction. This being the case, it results that a very large percentage of the roads built under the supervision of the State Highway Department have been of the earth variety. This type of road, when well constructed in the first place, especially if sand and clay are used in the proper proportion, and then well maintained, is capable of being made a first-class road, but it requires a great deal of attention and the attention given it must be at least of the semi-intelligent variety.

After all, with whatever type of road one has to deal, the factor next in importance to careful design and construction is careful maintenance, and this, unfortunately, is what so few of our Southern roads really get. In his paper Mr. Kerr makes the following significant statement concerning this phase of the subject: "The Highway Department recognizes the fact that maintenance in road construction is equal in importance to actual construction, and although the law provides for the care of highways by the State and parish, along lines of agreement similar to construction work, its endeavors towards coöperating with the parishes in this matter have not, so far, met with success. Unfortunately, experience has shown that local authorities, except in rare cases, cannot be depended upon to maintain the State aid highways after construction."

The above being true, it would seem wise to adopt some plan by which a larger percentage of the funds might be set aside for maintenance, even at the expense of constructing fewer miles of new roads in a given period of time. It would seem to be wiser to construct a few good roads and keep them in good order than to construct a great many roads and then

allow them to go to pieces. In some of the Middle Western States great success has been had in the maintenance of earth roads by the use of the simple log drag. These drags are operated by the farmers who live along the road, under the general supervision of the highway department. Each man is given a certain number of miles to look after and is paid a certain amount per mile for his time and the use of his team. In this way, at a small expense, the roads are well maintained, and some of those Western earth roads have the reputation of being the best roads in the country.

It is to be hoped that the Louisiana State Highway Department may soon see its way clear to some simple and economic solution of the problem of maintenance, and in that department show the same excellent results that it has attained in the department of construction and design.

Problems of the Contractor.—In these recent years no word has been more used, and probably none more abused, than the one word "efficiency." It has, of course, always been a word of daily use with the engineer, and a word of definite technical significance, but within the last few years its use has been rapidly extended into the discussion of sociological problems and the study of the human machine. So much so, in fact, that there are now magazines and systems of efficiency *ad libitum*, and it becomes possible for the sum of \$15.00 and the diligent study of twenty correspondence lessons to transform oneself from a poorly lubricated machine with lack of coördination among its various functions into a machine with an unlimited supply of energy and an efficiency of 100% plus.

But aside from the quackery which always arises in connection with any new movement, it is very significant how much more study is being given to the human machine with a view to improving its efficiency in its daily round of duties. Some of the best minds among the engineering and business fraternities have been devoting themselves in recent years to these problems, and the results of their researches have shown, as is brought out in Mr. Reynolds' paper on "Contractors'

Organization and Equipment," that a very large part of the success of any contractor depends upon a careful selection and study, both individually and collectively, of the men to whom he entrusts the carrying out of his plans. To put it briefly, the man who would be a successful contractor must now, in addition to having a thoroughly up-to-date mechanical equipment and a well-planned organization, devote a certain part of his thought and attention to the psychology of the human machine, and learn to manipulate it in such manner as to secure the very best results from each separate unit as well as from the whole organization.

Compensation of Engineers.—A special committee of the American Society of Civil Engineers has had under investigation for the past two years certain conditions of employment of, and compensation for, civil engineers. A progress report of this committee, submitted during the past winter, has in it some statistics, which it is believed will prove of interest to the members of this Society. The report appears in the form of four statistical charts. The first of these is general in character and gives a curve showing the average yearly compensation received after periods of experience of from one year to sixty-three years. According to this curve the average yearly compensation, starting at about \$1,200.00 for an experience of one year, rises at a fairly steady rate until it reaches a maximum of \$9,716.00 for an experience of twenty-nine years. This average is taken from the replies of fifty-two men. From this point on the curve has a downward tendency, the average of which up to fifty years of experience would be about \$6,500.00. After twenty-five years of experience the average compensation amounts to \$7,191.00, the result of replies from 106 men. The maximum yearly compensation amounts in two instances, at eighteen years and at twenty-seven years respectively, to \$150,000.00. (Note that the years here refer to years of experience, and not to years of age.) At these same periods the minimum compensation amounts to \$1,320.00 and \$1,800.00 respectively. The general average compensation,

taken as the result of the replies of 4,796 members of the Society, amounts to \$4,224.00.

The variation of compensation with character of employment is next shown by means of a set of curves and a tabular statement. The tabular statement is given herewith:

No. of Replies.	Nature of Service—	Average Yearly Compensation.
288.....	States and Counties.....	\$2,868.00
506.....	National Governments.....	3,038.00
590.....	Municipalities	3,225.00
206.....	Technical Schools.....	3,295.00
688.....	Railroads	3,516.00
1429.....	Private Companies.....	4,364.00
619.....	Consulting Engineers.....	6,740.00
140.....	Contractors	7,562.00
4466.....	Total General Average.....	\$4,216.00

The curves further show that for the first twenty years of experience, railroad, government, state and municipal engineers receive about the same rate of compensation and that the rate of increase of salary is also very nearly the same. Professors in technical schools, if income from their private practice is included, receive about the same rate of compensation as the above three classes. But beyond the twenty-year period the average salaries paid to railroad men is much higher than that received by any of the others. As for contractors, private corporation and consulting engineers, their yearly compensation increases at a very much more rapid rate than that of the other classes mentioned above and also reaches a much higher maximum.

The next diagram sets forth the compensation received, depending upon the geographical distribution of the men. These results have been tabulated from the replies received from 4,650 members of the Society.

No. of Replies.	Geographical Dist.—	Average Yearly Compensation.
547.....	Southern States.....	\$3,388.00
839.....	Western States.....	3,717.00
354.....	New England States.....	4,028.00
846.....	Central States.....	4,206.00
1608.....	Middle Atlantic States.....	4,333.00
456.....	Foreign Countries.....	5,306.00
4650.....	Total General Average.....	\$4,160.00

An examination of the curves indicates that the compensation of engineers in foreign countries is uniformly considerably higher than that of any of the men at home, and that the rate of increase with increasing experience is much more rapid.

It is interesting to note also that, in the different groups of States, the average yearly compensation is approximately the same and has about the same rate of increase for the first fifteen years of experience. Beyond that time the *rate of increase* in the Southern States begins to fall off, until the maximum is reached after twenty-five years of experience. In the other groups of States, on the contrary, the rate of increase remains practically constant, and the maximum is not reached until after a service of thirty-five years.

The fourth and final diagram shows a comparison between engineers who are graduates of technical schools and those who are not. Quoting from the report: "This diagram is of special interest owing to the fact that the curves for graduates and non-graduates follow each other very closely for the first fifteen years. The graduate engineers appear to have an advantage from that time on to about forty-five years, when the curves again come together."

"The average yearly compensation of 1998 graduates having an experience of from two to fifteen years is \$2,756. The average yearly compensation of 614 nongraduates having an experience of the same length is \$3,154. The yearly compensation of 1,394 graduates having an experience of from sixteen to 50 years is \$6,328. The average yearly compensation of 719 nongraduates having an experience of the same length is

\$5,359. This may be due to the fact that the preparation of the graduate engineers represented by that part of the curve between the fifteenth and forty-fifth years was more thorough in the fundamentals of engineering education, and that, whatever may have been their compensation in comparison with that of the nongraduates for the first fifteen years of their professional life, this thoroughness of preparation shows its effects from that time onward. It may be that among the nongraduates of technical schools only the most ambitious men apply for membership in the Society."

It is fact also, contrary to what is generally believed in this matter, that the average age of the nongraduates who become members of the American Society during the first fifteen years of experience is somewhat lower than that of the graduates.

Extra Copies of the Proceedings.—Members of the Society, who may desire extra copies of the journal, are requested to notify the Editor or the Secretary at least two weeks in advance of publication, in order that the proper orders may be given to the printer. Only a sufficient number of copies is printed of each issue to cover the needs of our regular subscription list, our exchanges, and advertising list, with a certain number of extras which are kept on hand for emergency calls and for binding at the end of the year. When extra copies are so ordered they will be furnished at the price of 15 cents each, to members of the Society only. According to our usual custom, the author of each paper is entitled to twenty (20) complimentary copies.

Material for the Proceedings.—So far the papers published in the PROCEEDINGS have been first read before the Society. The Editor feels convinced that there should be available for publication a considerable amount of matter, which it may not be practicable to work up into the form of a paper of sufficient length to present to the Society. Many members, no doubt, have interesting data in their notebooks, which they, themselves, may consider of not sufficient importance to warrant

putting into a special paper, but which, if written up in the form of a brief report, would prove an interesting contribution to our pages. Furthermore, a man may be doing some piece of construction work, the details of which are so familiar to him that he may overlook the fact that it may prove of considerable interest to another man who may have the same sort of problem with which to contend. A photograph of the work in progress, or of some special device for its efficient execution, with a brief description, would form a valuable contribution to the pages of our journal. One has only to glance over the pages of current journals such as this one to realize that a considerable portion of their matter is made up of just such short articles. It is hoped that our members will give this their careful consideration and that we may have many such communications.

Furthermore, it must not be forgotten that this journal is the official organ of the Society, and that its pages are open to the membership for discussion, not only of the technical papers published, but for comment upon, and general criticism of, the affairs of the Society as well. No persons, more than the officers of a society such as this, appreciate the value of constructive criticism and suggestions as to the best methods of carrying on its work and developing its usefulness.

The financial success of our journal seems to be fairly well assured, but no amount of advertising matter will keep it going unless its pages are full of interest to the members of the Society. It becomes the duty of each and every man, therefore, to contribute his share toward the successful solution of this part of the problem.

BOOKS RECEIVED

The Regulation of Rivers. By J. L. VAN ORNUM, Published by McGraw-Hill Book Company. (This book will be reviewed in a subsequent issue.)

BOOK REVIEWS

The Flow of Water in Open Channels. By FRED C. SCOBEEY, Irrigation Engineer, United States Department of Agriculture. Price 25 cents.

This is the title of Bulletin No. 194, United States Department of Agriculture, issued under date of May 10, 1915. As the title indicates, it deals with the problem of the flow of water in all sorts of channels such as are used in irrigation practice. Two hundred and sixty-nine experiments are reported; they include concrete-lined canals, wooden flumes, metal flumes, masonry lined canals, earth channels, cobble-bottomed canals, side hill cuts with retaining walls and miscellaneous sections representing a great variety of conditions.

The task undertaken by Ganguillet and Kutter was to furnish a method for accurately determining the so-called constant of the Chezy formula for any given set of conditions. It is, of course, known to engineers, who employ the Kutter formula in their work, that while the formula is in a certain sense empirical that it was based on eighty-one different gaugings of different channels varying from very small streams a few inches wide to the Mississippi River. The formula was developed in 1869 and contained such gaugings from the work of European engineers as were believed by the authors to be absolutely reliable; it also included the recent work of Humphrey and Abbott on the Mississippi.

Nevertheless, some engineers have used the Kutter formula with blind faith, while others have used it with many misgivings as to its universal application. Since the time the gaugings were made, on which the formula is based, methods of observation

and instruments used in hydraulic observations have changed somewhat. A new set of experiments was, therefore, needed covering a wide range of conditions, and this need has been met in Bulletin No. 194.

The range of mean velocities in various experiments was from more than twenty feet per second in a cement-lined canal, down to less than half a foot per second in some of the earth channels, with corresponding variations in slope.

The greater part of the experimental field work was done during the irrigating season of 1913 by employees of Irrigation Investigations, United States Department of Agriculture. The canals are located in the States of Nebraska, Colorado, Utah, Idaho, Oregon, Montana, California, Arizona, Texas and Louisiana. In the last two States the work was done by the writer, assisted by J. F. Muller, Jr. Both are members of the Louisiana Engineering Society.

Engineers who are wrestling with the problems of drainage canals will find that the low velocities and slight slopes of the rice irrigation canals experimented with will, in some measure, parallel the conditions with which they are dealing, as both velocities and slopes are extremely low.

The conclusions reached are briefly: that the Kutter formula is applicable to the design of any open channel and that the values of the coefficient of retardation, "n" recommended by the earlier writers, were in the main correct. The later work has given more exact classification of surfaces as determined by modern materials used in canal linings. A tendency towards a lower value of "n" was found in the results, as the velocity and hydraulic radius increase.

The bulletin contains some estimation charts that will be found useful in solving problems of open channel design. It forms a valuable addition to the literature of Experimental Hydraulics and has been highly praised by such men as John R. Freeman, Clemens Herschel and Mansfield Merriman.

W. B. GREGORY,

Professor of Experimental Engineering and Hydraulics,
Tulane University.

PAPERS AND DISCUSSIONS

LOUISIANA STATE HIGHWAYS.

By

C. M. KERR.

(Read before the Society, May 10, 1915)

To the General Assembly of the State of Louisiana, Session of 1910, during the term of office held by Governor Jared Y. Sanders, is due credit for the enactment of a law that will eventually cause this State to take its place in the foremost rank of prosperity.

By the passage of Act 49, requiring "the State Board of Engineers to assume control of State highways under certain conditions; to elect a State Highway Engineer; to define his powers and duties; and fix his compensation; to authorize the construction and maintenance of highways by contract or by the Highway Engineer; to provide for the working of convicts on highways under certain regulations; to authorize the acquisition, by expropriation or otherwise, of rights of way for highways, drainage canals, or ditches, to provide a revenue for carrying out the objects and purposes of this Act and to provide for the disbursement thereof, and to require the parishes, cities, town and villages to contribute a certain proportion of the costs of constructing and maintenance of highways; defining a State highway, and repealing all laws or parts of laws in conflict with this Act," authority and power was vested in this Board, which made possible the undertaking and carrying out of a project second to no other factor in the development of our State, except possibly levees, at any rate, in the alluvial portions of the State.

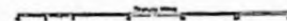
Prior to the passage of this Act, and the subsequent organization of the Highway Department, Board of State Engineers, which first came into official existence upon the morning of February 6, 1911, practically nothing had been done by the State to further the cause of good roads. In fact, previous to the year 1909, efforts at highway improvement in our State were confined to temporary spurts of energy here and there,

MAP
SHOWING SYSTEM OF PROPOSED
STATE HIGHWAYS
OF
LOUISIANA

AS ADOPTED BY
THE HIGHWAY DEPARTMENT
BOARD OF STATE ENGINEERS.

STATE HIGHWAY ENGINEER W. E. ATKINSON.

1913



on the part of individuals, parochial authorities, communities and others, in each case acting upon its own initiative, with limited and insufficient means, only attempting to accomplish something more advanced and serviceable than the trails and by-paths that were little more than nature herself had bestowed upon them. In this latter year, under a broad proposition advanced by the Governor of the State, the first step forward was made towards the systematic development of our public highways upon scientific lines, which later resulted in the passage of the law which made possible the construction of first-class roads throughout the State.

These preliminary efforts to furnish State aid, which a year later resulted in the final organization of a permanent Highway Department, consisted of an understanding between all interested factions, whereby the State should furnish all engineering services, through the Board of State Engineers, and the forces of the State penitentiary for all construction work through the State Board of Control; the police jury of each respective parish should furnish funds for the actual expenses incident to carrying on the various projects, and the United States Government should furnish supervision along model lines. This resulted in many excellent road projects, amounting to 103 miles of improved highways in six parishes, being proposed and executed during the following year, so much so that, at the next session of the General Assembly of the State in 1910, the Act creating the State Highway Department, Board of State Engineers, became a law.

This Act, together with an amendment to the State Constitution, provided for a State Highway fund, and various methods whereby State Aid may be granted any and all parishes. These methods are four in number and may be briefly summed up as follows:

- 1st. Monetary State Aid, whereby provision is made for the construction of highway projects by contract, to be paid for by the parish and State, in proportions agreed upon, the State's share being limited to not more than one-half of the total cost.

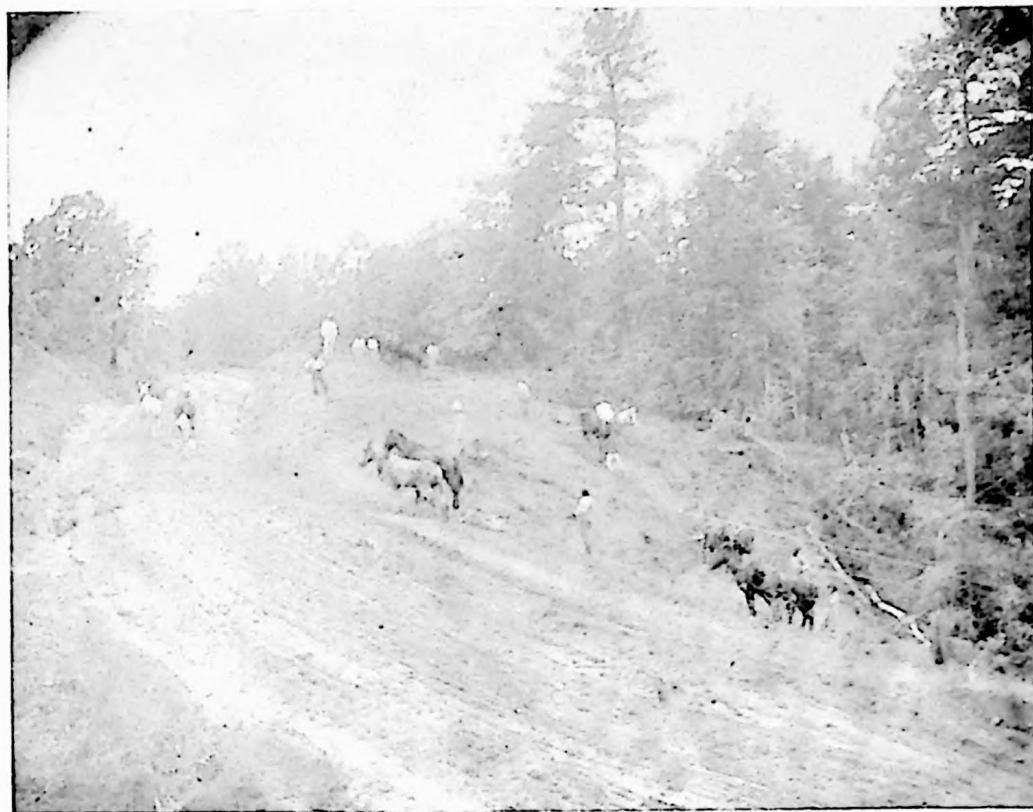
2nd. Convict State Aid, whereby provision is made for the construction of highway projects with convict labor, the parish paying all actual expenditures in connection therewith.

3rd. Road Outfit State Aid, whereby provision is made for the construction of highway projects with road equipment belonging to the State, the parish paying for all actual expenditures incidental to operating same.

4th. Force Account State Aid, whereby provision is made for the construction of highway projects with free labor, after any project has been advertised, and bids rejected, the cost in this case to be met by both the State and parish as in the case of monetary State aid previously mentioned.

Regardless of the method of granting this aid, one principle is strictly and consistently adhered to—all work must be carried on under the supervision of the Highway Department, Board of State Engineers, according to its standards and specifications.

While Act 49 stands out preëminently as a model of its kind, and casts unlimited credit upon its framers, there is, in the writer's opinion, one important section of it which needs remodeling, and this particular section refers to the State Highway Fund. The provision made in the original act does not create any fixed revenue for carrying on work, but states that all surplus revenues received by the Conservation Commission of Louisiana constitute a fund for this purpose, and all proceeds from any annual State tax that may be levied or collected for the purpose of constructing and maintaining the public roads and highways throughout the State shall constitute a State Highway Fund. Owing to the fact that to date the Conservation Commission has not had any surplus to extend to our aid, and as "a special tax of one-fourth of one mill on the dollar for the purpose of creating a road fund with which to construct and keep in repair the State highways" was not assessed until the year 1912, the State Highway Department had a rocky road, financially speaking, to travel for the first year



GRADING AND STRAIGHTENING AN EARTH ROAD IN
CALDWELL PARISH



THE SAME ROAD COMPLETED

of its existence, and would have fared ill indeed had not the Board of State Engineers had its resources to draw from to furnish the sinews of war at critical moments and keep the organization up, until the wherewithal to place it upon its own footing was finally provided. This special tax of one-quarter of one mill, known as Article 291 of the Constitution of 1913, amounts to about \$130,000.00 annually, and as this is the sole source of revenue at the command of the Department, it is not by any means an easy matter to make ends meet. The law provides that the expense of building roads be borne, one-half by the State and one-half by the parish, and that no one parish be aided to the extent of more than \$50,000.00 annually. Considering that there are sixty-four parishes in our State, it does not require a great exercise of the imagination to picture the condition of affairs should each and everyone apply for and insist upon aid in full. Fortunately, the officials of the various parishes realize the difficulties under which operations are perforce now carried on and are glad to get whatever monetary aid the Department finds it possible to extend, as they realize that no matter how much more a project may cost the parish than the State, the difference is more than made up in the Department's assuming all responsibility for carrying on the work, and furnishing trained supervision. Accordingly, before any project is advertised, an estimate of the proposed work is arrived at, and proportions of payment by the State and parish agreed upon. To date, this division of payment varies from half and half to one-tenth and nine-tenths of the total cost, the amount paid by the State depending upon the number of applications submitted by various parishes, and the magnitude of each contract. Should this section of Act 49, relative to the State Highway Fund, be further amended to provide a greater revenue than at present for the needs of the Highway Department to carry on its work, our State would have, in the writer's opinion, a thoroughly practical and efficient highway law.

The conditions under which the State Highway Department exists having now been briefly stated, an outline of its policies and aims will be presented. While it is apparent to

anyone who has studied road matters for a period of years that the advantages of improved public highways have been proved beyond all argument, we still have in several sections of our State a class of citizens who refuse to be convinced that they, or their community, can be benefited by any change, and regard the expenditure of any funds upon the construction of a high-class, permanent type of highway, as wasteful and totally unnecessary. As a result, the work of the Department has for the most part been largely of an educational nature, and although it has proven a difficult matter sometimes to get a foothold, it is gratifying to be able to say that success in demonstrating to any community, however skeptical it may be, the true worth of a good road, most if not all of the "doubting Thomases" seldom fail to sooner or later fall into line and accept as a fact what is best for them, and thus new converts to the cause of good roads are constantly being made.

At the very dawn of the new era that was ushered into our midst by the creation of the State Highway Department, the powers that be, in other words, the Active Board of State Engineers, realized that the construction of State highways, with public money, should be undertaken in a systematic manner, with some definite aim in view. To this end, it was proposed that the funds of the Department be devoted to the construction of a main public highway, forming a belt within the boundaries of the State, linking together the largest cities and towns. This proposed route started at New Orleans, and encircled the State, passing generally through Baton Rouge, Alexandria, Monroe, Shreveport, Lake Charles, New Iberia, Morgan City, and thence back to New Orleans. The general plan was to connect each one of the above mentioned successive points by as direct a line as practical, after which branch roads would be built as feeders to this main route. The idea, as you can readily appreciate, was to build roads along comprehensive lines, highways that started somewhere and ended somewhere, doing the greatest good to the greatest number. It was necessary to thus outline some definite plan of action, for if aid were given by the State indiscriminately, regardless of location or general importance, it might have resulted in any num-

ber of short, disconnected stretches of roads being built and improved, and a definite system of State highways would never have become a reality.

The destinies of the Highway Department were first entrusted to Mr. Gervais Lombard, who, under the title of Acting State Highway Engineer, took official charge, in the absence of a regularly appointed highway engineer. Mr. Lombard was then, and still is, an Assistant State Engineer and member of the Board of State Engineers, and owing to the necessity of practicing the strictest economy, instead of at once selecting a Highway Engineer, whose salary would necessarily have to be paid out of the then uncertain State Highway Fund, the Board of State Engineers delegated him to assume charge of affairs until the position of State Highway Engineer could be regularly filled. That Mr. Lombard fully carried out the work, mostly of a pioneer nature, to a successful degree during his control of affairs, is attested to by the fact that about 290 miles of highways were constructed in about fifteen parishes, and statewide interest in the cause of good roads was awakened by his earnest and consistent efforts, as it never before had been.

Mr. Lombard continued in the position of Acting State Highway Engineer until October, 1912, at which time the office of State Highway Engineer was regularly filled by the appointment, by the Board of State Engineers, of Mr. W. E. Atkinson.

Mr. Atkinson, at the time this selection was made, was engaged in the practice of the profession of civil engineering in the City of Monroe, having previously had considerable experience in both highway and railroad engineering. He at once assumed control of the affairs of the Department, and after nearly three years of active service is still devoting all of his time and energies to the task of lifting Louisiana out of the mud.

After assuming control of affairs, and studying carefully the highway situation in Louisiana, Mr. Atkinson decided upon a modification of the original plan for constructing the pre-

viously described belt linking the main cities and towns of the State.

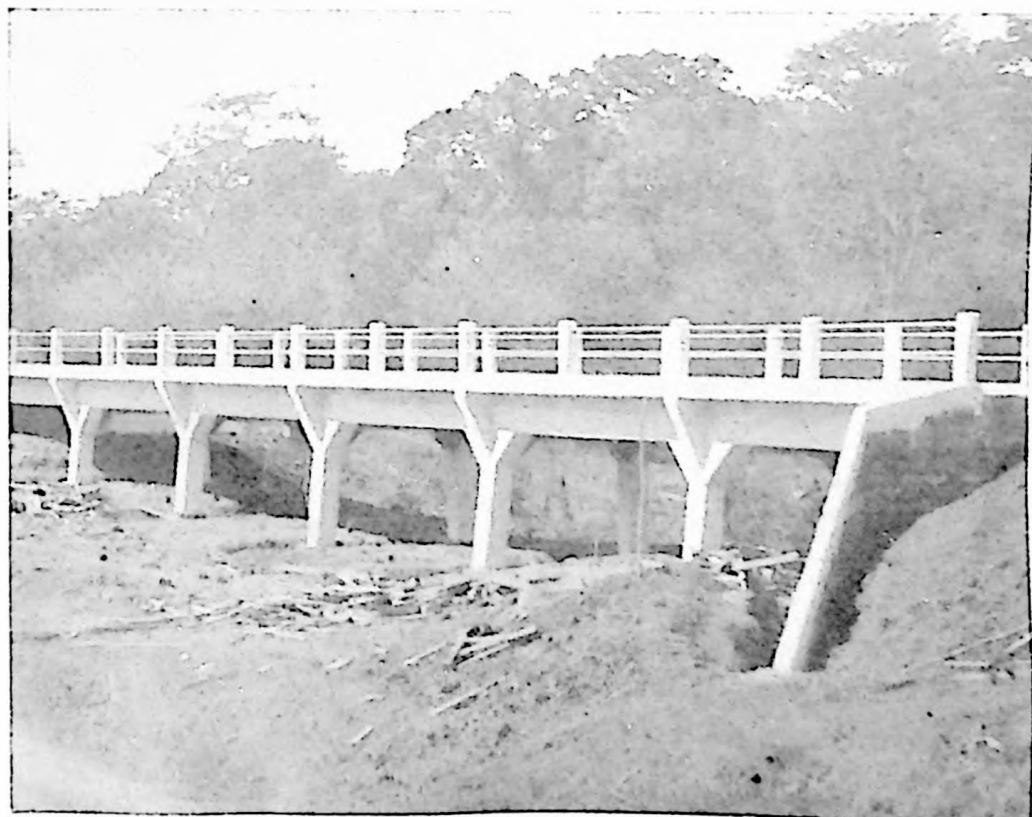
While thoroughly practical in itself and embodying many splendid features, there were two objections to conforming strictly to the original plan. The then proposed "belt" passed through but 50% of the parishes, and there was no guarantee that those which were touched by the location would apply for, or desire, State aid, and the coöperation of the Department. While the principle of building upon comprehensive lines was, in the main adhered to, the plan of location was somewhat changed, and a system of State aid highways was adopted and officially put into operation. This system embraces the construction of main highways connecting each parish seat with the parish seats of all the adjoining parishes, by as direct routes as are practical. After these main trunk lines are constructed, attention will be given to branch lines and feeders.

A close inspection of the map of the State will acquaint the inquiring mind with the fact that the Highway Department has undertaken a gigantic task in following out this plan. In the main system alone, there will be between 4,500 and 5,000 miles of road, and at the present time, with financial conditions in their existing state, it is safe to predict that our energies will be expended, for the most part, upon the construction of these first few thousand miles. This does not necessarily mean that all of the main roads will have to be completed before any branch roads are built. The Department deals with each parish as a single unit, and with the exception of locating through highways in adjoining parishes so that they will meet at the boundary lines, the affairs of each parish are absolutely independent of any other one. Therefore, as soon as a parish builds the required unit of the State system within its limits, it may, if the money be available, obtain aid upon branch lines. It is therefore possible for a parish to improve all of its highways in a minimum length of time, provided its citizens have the proper spirit of progressiveness, plus the necessary financial backing to bring about the needed reforms.

With the advance of modern institutions, the idea of system, economy and thoroughness becomes more and more fixed, and



EARTH ROAD IN PROCESS OF CONSTRUCTION THROUGH A SWAMP
CALDWELL, PARISH



TYPICAL REINFORCED CONCRETE BRIDGE, BOSSIER PARISH

the scientific handling of all affairs of the present day, whether private or public in nature, is imperative. To this end, the State Highway Department is lending all its energies by building with an eye to the future, along economic and practical lines, striving to get the best returns for the funds with which it is entrusted.

Public highways of modern construction should be modelled along lines of permanency. This does not mean that it must be everlasting in nature, for from an economical standpoint, traffic conditions must necessarily regulate the type of highway required in each locality. But, before a highway be built, a careful and thorough survey should be made, and the location of any proposed highway should be, with due regard to economy of construction, the most direct route between objective points. Accordingly the State requires the following rules and regulations relative to the construction work:

After the police jury of a parish notifies the Department that it desires State aid for the construction of a highway or highways, it is required to pass a resolution applying for this aid, stating the location of the proposed routes along which it is desired to build, and guaranteeing to pay the actual cost, less salary of engineer in charge, of all investigations and surveys. If the location of the proposed work be embraced within the system of State aid highways, the necessary survey is made.

This survey is complete in every detail, no matter what the type of highway will be. All necessary preliminary lines are run, after which a permanent location is decided upon, drainage conditions are thoroughly investigated, and all data that may prove of value in estimating the cost of constructing are carefully obtained.

A complete set of specifications, maps, profiles, bridge and culvert plans, and typical road sections are prepared, blue prints of which are furnished the parish police jury, together with a report upon the approximate quantities and cost thereof of the proposed work. In most instances the type of highway is definitely decided upon by the time the before-mentioned report is made, but in some cases, estimates are made upon two or more classes of construction, the police jury deciding which

one it desires to build, this decision being governed by the available funds at hand, and the amount of territory that it is wished to cover. After having definitely arrived at a decision, the police jury then authorizes the State Highway Department to advertise the work, and invite bids, according to law. Proportions of payment are agreed upon between the State and parish, a limit being set upon the State's monetary obligations, the proposed work is advertised, and a date set aside for the opening of competitive bids, to be opened in the office of the State Highway Department. Upon the date set, the officials of the Board of State Engineers and of the Highway department, and the President of the Police Jury, or his officially appointed representative, assemble, and receive and open bids.

If a satisfactory bid is received, the Department recommends its acceptance by the police jury. Upon being approved and ratified by the latter, the contract is duly signed by all concerned, bond, amounting to one-half the amount of the contract, is exacted from the successful bidder, and the work started as soon as practicable.

During construction, the Department has a representative, known as a Resident Engineer, continually in charge of all work.. The principal duties required of him are to see that the work is carried out in a thorough and workmanlike manner, as per contract, plans and specifications. He cross-sections the work, sets all grade and slope stakes, lays out drainage ditches, computes all quantities, makes weekly progress reports, and at the end of the month furnishes data for the issuing of a monthly estimate, and at all times gives the work his personal attention.

While the foregoing deals specifically with Monetary State Aid, the same general rules govern all other forms of aid previously mentioned. In cases where the amount of work does not exceed \$2,000.00, the Department has the right, according to law, to award a contract without the formality of advertising and opening bids.

Except in the case of force account and convict construction, all contracts are let upon a unit price basis, and this method has proven, beyond argument, most satisfactory.

Owing to the fact that the Department desires to be absolutely just and impartial in applying its all too meager funds among the parishes desiring to secure State aid in the improvement of their highways, it has adopted the following plan. At least once a year, a circular letter is sent to the police jury of each parish, notifying it that upon a certain date, the State highway fund will be prorated among those parishes making proper application before a stated time, so that all necessary surveys, investigations and reports can be compiled before this division of the highway fund is made. This affords each and every parish a fair and equal opportunity to share in the benefits of this fund.

As a result of the constant and conscientious efforts of the State, through its Highway Department, the extended use of motor vehicles, and the general spirit of progressiveness which is now sweeping the State, there is a widespread awakening in Louisiana to the necessity of constructing good roads.

The people of the State, as a whole, are beginning to view the question of highway improvement in a broad light, and realizing that the prosperity of any community depends upon the traffic facilities, seem eager and willing to tax themselves to get desired results. The benefits that necessarily follow highway improvement are manifold, and, in a general sense, may be classified as follows: Economic advantages and social advantages. Under the former heading, the most attractive features are: first, the decrease in the cost of hauling, resulting from shortening of distances, reduction of grades, and permanent wear and weather resisting road surfaces which make travel possible the whole year around; second, the inestimable effect of improved highways upon the betterment of agricultural conditions, as the success of the business of farming essentially depends upon the condition of country roads, as no cause limits the scope of the activities of the farmer as effectively as bad roads; third, increase in the value of farm lands, due to the ideal hauling and agricultural conditions, namely, by improving the site value, by virtue of its situation with respect to markets, schools and towns; and last, but not least,

may be mentioned the effect of good roads upon the increase of tourist travel.

The chief social advantages relate to the improvement of schools, of rural delivery mail service, and of social intercourse.

The arguments against bad roads, and in favor of good roads, are so numerous and diversified that it would be almost impossible, in this limited time, to attempt a comprehensive discussion of them. It is particularly gratifying to realize, however, that the citizens of Louisiana are becoming more and more enthusiastic good roads partisans, and the movement to build a statewide highway system is annexing more ardent supporters every day.

As a result of the awakened interest in road improvement, taxes have been levied by popular vote, and bonds issued, in various parishes, solely for the construction of good roads. Sometimes this tax is parish wide, but generally road districts are formed, setting aside portions of a parish in which the citizens unite for matters of local importance and interest, and funds are raised by the levying of taxes, or in other ways, to carry out some specific highway improvement.

While the local authorities, in some instances, still operate under the old order of affairs, and manage their road interests entirely themselves, the growing tendency is to apply for assistance, both monetary and supervisory, from the State Highway Department.

Besides lending every effort to the parishes in regard to road construction, the Department has issued a book entitled:

*Gamble's
Compendium of the
Law of Roads
In
Louisiana
with
Forms for Bond
and
Tax Elections.*



ASPHALT-GRAVEL ROAD JUST AFTER BEING GRADED
NEW IBERIA—JEANERETTE



ASPHALT-GRAVEL ROAD. FIRST LIGHT ROLLING.
NEW IBERIA—JEANERETTE.

This book, compiled by the Hon. Harry Gamble, Assistant Attorney General of Louisiana, contains information ordinarily required in the issuance of bonds and the voting of special taxes for highway purposes in Louisiana, and supplies a long-felt need relative to those matters, and is furnished free of charge to any interested individual or community.

To date the Department has undertaken and supervised the construction of highways under all four forms of State aid hereinbefore described.

Most of the construction has been done under the contract system, with convict built highways coming next, while the percentage of force account and State outfit work is very small.

Relative to the cost of construction, in the writer's opinion, the most economical method is that which employs the use of State convicts.

The greatest percentage of convicts in this State consists of negroes, who, when properly governed and directed, rank second to none as laborers. By actual experience, it has been ascertained that the cost of maintaining and operating one convict per year on road work in Louisiana is about \$170.00, or between 45 cents and 50 cents per day. With this labor, one has at his command well-fed, well-clothed, healthy, able-bodied men on hand at all times, who can be depended upon to give value due. Compare this form of labor, at an expense of 50 cents per day, with the shiftless, ill-nourished, undependable free negro labor, of which contractors must of a necessity mostly depend, at twice and three times the cost, and you can readily understand the basis of the claim.

About 155 miles of improved highways have been constructed with convict labor in our State. This includes about twelve (12) miles of gravel road, the remainder being of the earth and sand-clay type. *The saving due to this form of labor and construction, as compared with similar work performed by contract, ranges from 40 to 60 per cent. Had these highways been of a higher class of construction, thus not necessitating such constant moving of camps, it is firmly believed that a still greater saving might have been effected. As it is, earth and sand-clay roads have

*See Tables in the supplement to this paper.

been constructed under the convict system at from \$750.00 to \$1,000.00 per mile, while the gravel surfaced roads cost on an average of \$4,000.00 per mile.

Unfortunately, the construction of State highways under this system was, owing to causes over which there was no control, of only a short duration.

Other works of public improvement, upon the construction and maintenance of which the State was immediately more vitally concerned, demanded the withdrawal, for at least the time being, of the convict forces from highway work.

Particular reference is made to the construction and maintenance of the public levees of the State, which, by reason of two successive periods of extreme high water in the valley, entailing more readjustment than usual, had to be given precedence over all else.

Therefore, at present, all work in progress by the Highway Department is being prosecuted under the other three methods of State aid, and while, of course, the standard of efficiency is in every respect maintained, the funds so far available to the Highway Department, of necessity cannot reach as far, nor accomplish as much by possibly one-half, as that which would be possible with convict labor, properly handled.

When the demand for convict labor in the other fields becomes less exacting and imperative, it is hoped that the Department may again enjoy the benefits of its services, thus again permitting this form of aid to the parishes of the State, and the great benefits to be thereby derived.

Besides paying his debt to the State and community, whose laws he has sinned against, by rendering valuable service during the length of his term, the convict is given the benefits of good, healthy outdoor exercise, and can make himself proficient in one or more details of highway construction, so that at the expiration of his term, instead of being turned loose a burden to himself and society, he is able to find employment with little difficulty, as the movement of highway improvement is steadily gaining headway and there is a constantly increasing demand for skilled labor.

Viewed from every angle, the writer considers it very unfortunate that this form of State aid was not lasting, and hopes that the time is not far distant when we will be able to avail ourselves once more of the use of State convicts in highway construction, and that, when it does come again, it will be a permanent acquisition.

The Department owns one road outfit, and to date has given aid to two parishes by its use, namely, St. John and Sabine. Very satisfactory work, upon a small scale, was performed by this method of construction, the outfit at present being in the last named parish.

The scope of force account aid has been limited, but has proved successful when tried, and where used in cases where bids were rejected for being excessive, the respective work was carried out somewhat more cheaply than the prices bid.

As previously stated, by far the greatest amount of work done by the Department has been under the contract form. To date, 252 miles of improved highways have been completed by contract, of which 38 miles are of gravel, 37 miles of shell, and 177 miles are of earth and sand-clay construction. Besides this, there are at present 164 miles of highway under construction, there being included in this work 102 miles of gravel and 62 miles of earth and sand-clay highways.

A comparison between the mileage of completed and current work plainly shows that the proportion of surfaced highways is becoming larger, and, no doubt, the time is not far distant when the permanent type will, as it should, be adopted almost entirely. At the present time, the activities of the State Highway Department embrace in all 430 miles of completed highways, 164 miles under construction, and about 440 miles of proposed highways surveyed and investigated, from which nothing definite has resulted.

The Highway Department recognizes the fact that maintenance in road construction is equal in importance to actual construction, and although the law provides for the care of highways by the State and Parish, along lines of agreement similar to construction work, its endeavors towards coöperating with the parishes in this matter has not, so far, met with suc-

cess. Unfortunately, experience has shown that local authorities, except in rare cases, cannot be depended upon to maintain the State aid highways after construction.

While still hampered by insufficient funds, the Department is constantly striving towards a forward goal, covering as much ground as is practical, and maintaining a high standard of efficiency.

In all instances, "the garment must be cut to fit the cloth," and so, according to available funds, the class of highway built ranges from metal surfaced roads with concrete drainage structures to sand-clay or earth roads with timber bridges and corrugated galvanized iron pipe culverts.

Besides the above-mentioned classes, which represent the highest and lowest type of construction, there are several intermediate types of highway which the writer will not attempt to describe at present.

The various details and phases of the work connected with this most important subject cover such a broad field that there is, in a measure, no end to argument and discussion, therefore the writer will not venture further upon this topic, as in a general sense the scope of the operations of the State Highway Department has already herein been covered.

However, owing to the fact that to date, 36 out of the 64 parishes have applied, in one way or another, to the Department for aid, it is safe to state that the spirit of progressiveness is with us to stay, and the future holds bright prospects for Louisiana, as every mile of improved highway means another stepping stone along the path of progress and prosperity.



GRAVEL ROAD IN PROCESS OF CONSTRUCTION
BATON ROUGE—HOPE VILLA



THE SAME ROAD COMPLETED

SUPPLEMENT TO "LOUISIANA STATE HIGHWAYS"

STATEMENT SHOWING MILEAGE OF GOOD ROADS CONSTRUCTED
WITH CONVICT LABOR, COST OF SAME AND COST PER
MILE FROM APRIL 20, 1908, TO APRIL 20, 1914.

PARISH	General Character	Mileage	Cost	Average Cost per Mile
*Natchitoches	Earth	37.23	\$ 29,021.01	\$ 779.51
†DeSoto	Sand-Clay	50.39	43,797.59	869.17
‡Ouachita	{ 4¼ Miles Gravelled, 13 Miles Earth }	17.25	25,089.16	1,454.44
Rapides	Earth	3.57	3,273.50	916.94
†East Baton Rouge	Earth	22.22	23,400.53	1,053.13
Orleans	Earth	15.50	16,110.11	1,039.36
City of Baton Rouge..	Wide Gravel	.82	5,023.08	6,125.71
St. John the Baptist..	Earth	8.00	7,200.00	900.00
Total.....		154.98	\$152,914.98	

* 3 miles sand-clay.

† 5 miles "natural gravel."

‡ Ouachita Parish { Average cost 4¼ miles gravelled road.....\$3,196.58
Average cost 13 miles earth road 884.90

† This item includes the cost of 1.1 miles of drainage canal, costing approximately \$3,093.70.

	Miles	Cost	Average Cost per Mile
Total Earth Roads Constructed.....	99.52	\$ 90,508.85	\$ 909.45
Total Sand-Clay Roads Constructed.....	50.39	43,797.59	869.17
Total Gravelled Roads Constructed.....	5.07	18,608.54	3,670.32
Total.....	154.98	\$152,914.98	

Average cost per mile of all roads constructed.....\$986.67

STATEMENT SHOWING LOCATION, LENGTH, CHARACTER AND COST OF
HIGHWAYS CONSTRUCTED BY THE HIGHWAY DEPARTMENT
OF THE BOARD OF STATE ENGINEERS OF LOUISIANA
UP TO MAY 1, 1915.

NAME OF HIGHWAY	PARISH	Mileage	Character	TOTAL COST	Average Cost Per Mile
Colfax—Rochelle	Grant	30.10	Earth	\$ 56,151.04	\$ 1,865.48
Pollock Branch	Grant	12.87	Earth	27,722.09	2,154.00
Mansfield—Logansport	DeSoto	20.00	Earth	36,082.30	1,304.11
Toca Settlement	St. Bernard	3.00	Shell	12,245.32	4,081.77
Secs. 2 & 3, E. Carroll Parish	E. Carroll	38.00	Earth	49,281.78	1,296.83
Colfax—Montgomery	Grant	15.50	Earth	35,950.62	2,319.39
Montgomery—New Verda	Grant	8.60	Earth	18,941.37	2,202.48
New Iberia—Jeanerette	Iberia	9.50	Petrolithic	53,876.72	5,671.23
Pt.-a-la-Hache	Plaquemines	33.00	Shell	101,909.59	3,088.16
Winnsboro Highways	Franklin	12.00	Earth	18,881.70	1,573.47
Many—Fort Jesup	Sabine	11.00	Earth	28,337.88	2,576.17
Mansfield Highway	Caddo	10.80	Gravel	79,101.58	7,787.18
Belmont—Sodus	Sabine	10.00	Sand-Clay	32,050.74	3,205.07
Mansfield—Benson	DeSoto	12.00	Earth	22,850.86	1,904.24
Tallulah—Lake Providence	Madison	9.00	Earth	32,460.37	3,606.71
New Iberia—Lafayette	Iberia	4.50	Earth	9,604.83	2,134.40
Section 1, Arkansas	Caddo	5.00	Gravel	33,453.33	6,690.66
Columbia—Colfax	Caldwell	1.00	Earth	2,943.90	2,943.90
Many—Mansfield	Sabine	6.00	Earth	10,512.60	1,752.10
Poydras—New Orleans	St. Bernard	0.30	Shell	1,191.09	3,970.03
Many—Negreet	Sabine	10.00	Earth	24,129.00	2,412.90
Many—Belmont	Sabine	11.00	Earth	19,805.00	1,800.50
Total		273.17		\$707,483.71	

STATEMENT SHOWING LOCATION, LENGTH, CHARACTER AND
COST TO DATE OF HIGHWAYS UNDER CONSTRUCTION,
UP TO MAY 1, 1915.

Name of Highway	Parish	Mile- age	Charac- ter	Total Cost to Date
Columbia—Rayville	Caldwell	4.00	Earth	\$ 26,324.63
Baton Rouge—Hope Villa.....	E. Baton Rouge	14.00	Gravel	79,695.71
Bossier City—Benton	Bossier	13.30	Gravel	64,496.85
Bossier City—Ninotch.....	Bossier	25.40	Gravel	112,429.00
Shreveport—Homer	Bossier	6.30	Gravel	41,530.48
Covington—Franklinton	St. Tammany	16.50	Earth	27,830.94
Hammond—Covington.....	Tangipahoa	13.00	Gravel	14,348.01
Hammond—Baton Rouge				
Baton Rouge—Clinton	E. Baton Rouge	10.50	Gravel	2,203.00
Baton Rouge—Greensburg	E. Baton Rouge	7.46	Gravel	4,069.00
Baton Rouge—St. Francisville..	E. Baton Rouge	9.50	Gravel	7,982.50
Covington—Slidell.....	St. Tammany	26.26	Earth	1,821.56
* Jena—Colfax	LaSalle	5.00	Earth	
* Section 2, Arkansas	Caddo	3.00	Gravel	
* Abbeville—Kaplan	Vermilion	9.00	Earth	
Totals.....		163.22		\$ 382,731.68

* Contract let but work not yet started.

STATEMENT SHOWING AMOUNTS EXPENDED MAINTAINING
AND REPAIRING STATE AID HIGHWAYS
AFTER CONSTRUCTION

Name of Highway	Parish	Character	Cost
Callhoun Model Road.....	Ouachita	Earth	\$ 598.14
(Sect. 1) East Carroll Parish.....	E. Carroll	Earth	980.00
(Sect. 3) East Carroll Parish.....	E. Carroll	Earth	1,650.00
(Sect. 2) Pointe-a-la-Hache.....	Plaquemines	Shell	2,973.69
(Sect. 3) East Carroll Parish.....	E. Carroll	Earth	12,515.99
(Sect. 1) East Carroll Parish.....	E. Carroll	Earth	2,464.83
Plank Road (Sect. 2) Pt-a-la-Hache	Plaquemines		827.89
Installing Culvert, Lake Providence, Ark.....	E. Carroll	Cor'gt. Iron..	110.00
(Sect. 3) Pointe-a-la-Hache.....	Plaquemines	Shell	346.40
			\$ 22,466.94

RECAPITULATION

Highways Constructed:—	Mileage	Cost
Gravel { By Convict Labor	5.07	
{ By Contract	15.80— 20.87	\$ 131,163.45
Shell—By Contract	36.30	115,346.00
Earth { By Convict Labor	149.91	
{ By Contract	211.57—361.48	560,012.52
Petrolithic	9.50	53,876.72
Totals	428.15	\$ 860,398.69

Highways Under Construction	Mileage	Cost to Date
Gravel	102.46	\$ 326,754.55
Earth.....	60.76	55,977.13
Totals	163.22	\$ 382,731.68

Highways Constructed.....	428.15	\$860,398.69
Highways Under Construction.....	163.22	382,731.68
Maintenance and Repair.....		22,466.94
Totals.....	591.37	\$1,265,597.31

Discussion Upon "Louisiana State Highways."

THE CHAIRMAN: You have heard this very interesting paper of Mr. Kerr; I think we can have some very good discussion on it, and I will be very glad to hear from anyone. I want to state that I never realized that our State was being so well taken care of on highways, and some day, when we all get machines, we will appreciate it.

Does anyone care to discuss this subject?

MR. MANLEY: I notice you haven't any wood blocks in this highway business?

MR. KERR: I will state that we are gradually working towards permanency, and when we get to that point, we will use the highest and most lasting types of surfacing in our highway work.

MR. MANLEY: I think that the paper is an exceedingly fine one, and it shows me what is being done to a greater degree than I have ever known before. I would like to ask Mr. Kerr, is not there some work being done in Calcasieu parish, in which brick is being used?

MR. KERR: Yes. Calcasieu is doing all of this work by herself, to date. We have, however, made several surveys in the parish, and are now advertising an important project from Lake Charles to Westlake, to be constructed under our supervision.

MR. MANLEY: How many miles are they undertaking on brick work?

MR. KERR: I do not know exactly; I should say somewhere around eighteen miles, the remainder of their work being of gravel, shell and earth construction.

MR. MANLEY: You put them on a concrete foundation, do you not?

MR. KERR: No; it is my impression that they use a gravel foundation.

MR. MANLEY: Do they grout the brick?

MR. KERR: Yes.

MR. HOGG: How wide is the brick work?

MR. KERR: I believe, ten feet wide, with gravel shoulders. It makes a full path roadway, twenty-four feet in width.

MR. WILLIAMS: I think it would be of interest if Mr. Kerr would explain the different lines of the map, the red and yellow lines, and the white lines.

MR. KERR: As I explained, the purpose of these highways is to connect the parish seat of each parish with those of the surrounding parishes; the white lines show the proposed routes to be taken, just in a general sense, of course, while the red lines show what has been constructed, and what is under construction; and the broken white and red lines indicate the ground that has been surveyed and investigated, and the yellow lines show what has been accomplished by the parishes. Of course, there are several parishes about whose local work we know nothing, and, therefore, this map does not show what has been done in them. But the map indicates, in Calcasieu and Caddo, approximately what has been done by the local authorities. While the Department has, to date, done no construction work in Calcasieu parish, fourteen miles of gravel roads have been constructed in Caddo under State aid.

MR. LEWIS: What do you mean by the work that is done by the local authorities?

MR. KERR: By local authorities I mean the police juries of the respective parishes. Several parishes have undertaken highway improvement upon systematic lines without outside aid. I might mention Calcasieu, Caddo and St. Bernard parishes as being the most progressive ones in this class.

MR. WILLIAMS: According to that plan, then, Calcasieu has done a great deal of work?

MR. KERR: They have done a great deal; there are some earth roads constructed that are not indicated on this map, and the work in Caddo is pretty well up to what is shown on the map. Calcasieu has voted the largest bond issue of any country parish in the State; in fact, the parish has the money and is doing splendid work over there.

MR. ANDERSON: I should like to ask how the State Highway Department provides for the *maintenance* of these roads. Over in St. Tammany parish, I believe, some model clay roads are now being built. My experience in living over there in the summer time has been that, up to the present time, after the roads

have been completed and automobiles and other vehicles run back and forth over them, there is nothing left of the roads. The common method of working a road over there, as used by the parish authorities, is to dig the mud out of the side ditches and throw it into the middle of the roadway. The vehicles avoid these high spots, with the result that the road soon becomes an unused elevation in the center with a poor roadway on either side. The point I wish to emphasize is whether these roads that are built with the coöperation of the State Highway Department will stand up more than the old-fashioned roads, and whether they will be properly maintained. Proper maintenance is the really important factor in the problem of good roads.

MR. KERR: The State Highway Department has got to help maintain the roads constructed under its supervision in each parish of the State. The nature of the soil in St. Tammany parish is rather sandy, and in dry weather, it does go to pieces, and gets very dusty, and really, the thing to do is to eventually put some permanent surfacing on the roads, otherwise it would be almost impossible to keep them in condition in dry weather. Of course, after a rainy spell, the roads can be kept up by dragging, otherwise they will have trouble with them right straight along.

MR. ANDERSON: Does that coöperation mean that the State Highway Department will send an inspector over there?

MR. KERR: It means that the State Highway Department is obligated to help maintain all State aid roads, and its business will be to look after the maintenance of the State highways, and an inspector will have to make regular trips, and see that the work is kept up.

MR. MANLEY: In the event that the parishes should fail to provide funds for that maintenance, what is going to be the result?

MR. KERR: Should the parishes fail to pay at least one-half of the cost of maintenance of State aid roads, the State will not take any active part in keeping a highway up. The law is plain upon that point, and unless the parish coöperates with the State according to Act 49, no State aid maintenance will be provided.

MR. MANLEY: And the Highway Department could not even

go to the extent of maintaining one-half of those roads without the coöperation of the parish?

MR. KERR: We absolutely cannot do anything without the parish's coöperation.

MR. MANLEY: What do you estimate the life of the average road?

MR. KERR: Well, it all depends on the nature of the road. The higher the type of construction, the less the surface is affected by traffic. No matter what the class of construction may be, however, there is always more or less maintenance necessary, and the life of the average road depends upon traffic conditions, type of road, and the care taken of it.

MR. MANLEY: Is the road drag used very much?

MR. KERR: Yes; but not as much as it might be. I have some cuts of a drag right here that I brought down to-night, that I think would be of interest.

MR. MANLEY: If there is anything that will put an earth road into good condition, it is the split log drag scientifically used. The man riding upon the drag can shift his weight from side to side, thus bringing pressure at the desired point on the steel plate which cuts the surface. I have seen a great deal of these split log drags in Kansas, and they are used there with the greatest success upon the earth roads. The farmers along the route of the highway are paid so many cents per mile to operate these drags, and by doing the work systematically in this way they are able to get a great deal of it done. And one of these earth roads, when thus properly maintained, could not be better if it was paved.

THE CHAIRMAN: While we are on the subject of split log drags, we have some cuts here that I think Mr. Kerr has intended for distribution.

MR. KERR: Mr. President, the position of the State has not been stated quite as I think it should be. The law requires that the State shall maintain all roads that have been built in coöperation with the local authorities. One-half of the cost of such maintenance shall be charged to the parish in which the road may be located or may have been constructed, and it is the part of the parish to reimburse the State for its share of that cost; now, the time has arrived when the State

Highway Department is going to set aside a certain sum of money for the maintenance of these roads, even if it has, for a while, to limit the amount of construction of new roads, and devote a certain part of its revenues for the maintenance of the roads; otherwise, as has been said here by several, most of these roads that have been constructed are likely to go to pieces. As soon as the State Highway Department sets aside this amount, which, at first, can only be a nominal sum, then the officials of the parishes in which the roads are being built will be required to put up an equal amount, and if they do not do so, then such parishes will be permitted to let their roads go to pieces, but those who will do the work and pay their share, will get the aid of the State funds to help them along.

MR. YOUNG: I would like to ask Mr. Kerr if any consideration has been given to the use of burnt clay. In the roads in Arkansas and Oklahoma, I know that this has been used in a good deal of railroad work, and I think that in certain sections of the State they will find it very advantageous to use burnt clay. Wood is plentiful, and while the fuel is suitable, I should think that it would make very good road material.

MR. KERR: There has just been one instance in the State that I know of where a burnt clay road has been completed. About a mile west of Tallulah, in Madison parish, about five miles of road of this kind were constructed. This was six or seven years ago, and I was over that road within the last two years, and in spite of the fact that it has never been maintained, it is in good shape, and it is as good as the average improved road in the State. There is no doubt that a splendid type of road could be constructed by this method. The Department has given consideration to this type of construction, but has never attempted to build a road of burnt clay. Some experiments were made with natural gas as fuel, but owing to insufficient equipment and lack of funds, nothing definite resulted.

MR. YOUNG: Speaking of this, have you made any experiments in oiling roads?

MR. KERR: Yes; in Baton Rouge we have oiled seven miles of gravel road.

MR. MANLEY: How long ago was it oiled?

MR. KERR: It is not finished yet.

MR. MANLEY: Does it not cost less to maintain an oiled road than one that is not oiled?

MR. KERR: If it is properly oiled, it would; but if it is improperly oiled, you are liable to do more harm than good.

MR. COLEMAN: How does the burnt clay road compare with the gravel or macadam road for quality? Is it as good as either of them, or is it better?

MR. KERR: Well, I have never had any experience with it to any extent, therefore I cannot say much about it.

MR. COLEMAN: From such impressions as you have gathered?

MR. KERR: From what I saw of the burnt clay road in Madison parish, it has so far certainly held up wonderfully.

MR. COLEMAN: Has it held up better than a properly constructed gravel road?

MR. KERR: Under equal conditions, I should say that it has held up equally as well.

MR. HOFFMAN: It looks very much like an asphalt pavement, but it is very expensive. You have to have good timber for fuel, and that runs the cost up.

MR. COLEMAN: I was going to ask about what the relative cost per square yard would be by comparison with the gravel, crushed stone and macadam, in the State of Louisiana. Is it very much more expensive?

MR. KERR: Unless the conditions are ideal, and fuel plentiful and cheap, I should think that it would be more expensive. One feature in the burnt clay road is that you don't have to pay the excessive freight rates that you have to pay for gravel and stone. Of course, it all depends upon whether you have the fuel or not, and if you are running through woods or forests, I think it would be cheaper than the other two roads, if the burning was handled economically.

MR. COLEMAN: Mr. Chairman, the reason I have been asking Mr. Kerr about the relative value of the burnt clay road and the relative cost of the burnt clay road by comparison with the gravel and the crushed stone, is because of the line of thought that was opened up by Mr. Young's question. I think all of us have heard about burnt clay as the proper material for road metal, and I think it is universally recognized that it makes a

very excellent highway. It seemed to me that the principal feature of this question was that the burnt clay road costs more money in Louisiana than the gravel road or the macadam road would cost in Louisiana, and that the difference between the cost of the gravel or macadam road and the burnt clay road is not sufficient to justify the use of burnt clay, except in some few locations in this State, and while it is true that the burnt clay road does present the appearance of an asphalt road, as Mr. Hoffmann has stated, it is equally true that the macadam road which has been treated with the proper brand of oil likewise presents the appearance of an asphalt road, and so far as my personal judgment goes, I don't see that the burnt clay road is really any better than the macadam road, which has been well oiled with the proper oil, or than the gravel road that has been well oiled. So, if it costs any more money than either of those two roads, and is not a better road, why, that's the reason we don't have any burnt clay roads.

THE CHAIRMAN: Does any other member care to discuss this question?

MR. GREGORY: Mr. President, I merely want to express my admiration of the paper, and to move a vote of thanks of this meeting for the fine paper that we have heard to-night from Mr. Kerr.

The motion was duly seconded.

THE CHAIRMAN: You have all heard this motion, to offer a vote of thanks to Mr. Kerr for his interesting paper. All in favor will please signify by saying aye.

The motion was unanimously carried.

A. M. SHAW (by letter): As a member of the technical papers committee of this Society, I would feel considerable pride over our having been responsible for securing such a contribution as has been given to us by Mr. Kerr if it were not for the fact that the idea originated without the committee and for that reason our pride will have to be only that which can be honestly claimed by any other of our two hundred or more members. The paper under discussion has a value other than as a contribution to engineering literature, for it shows that as a Society, we have failed to appreciate the available resources that we have in our younger members.

Our attention has been called to the fact that while the plan of the Highway Department, as at first organized, was to construct a more or less complete system of through lines of good roads throughout the State, it has been found necessary to modify this plan, for the present at least, and build local roads to serve local requirements. The writer is of the opinion that the State is to be congratulated on account of this wise change in policy on the part of the Highway Department. A complete system of hard roads, traversing the State in all directions and furnishing arteries for long-distance automobile travel, would be desirable and would assist in advertising the possibilities of the State, but it is doubtful if any State can afford to construct such highways at the expense of those needed for local use, for, after all, the through lines are more or less of the nature of an expensive luxury. We must have such luxuries, but we can afford to wait for them. On the other hand, rural community roads are an absolute necessity to the economic and social development of the section, and other things being equal, this development will just about keep pace with the roads that are built for the interchange of commodities and the transportation of the residents. Each community, with its markets, its churches and schools and its social affairs, forms a unit with more or less well-defined boundaries, and it is only by studying the needs of each of these units, as well as by following good engineering practice in the construction of roads, that a State Highway Department can get the most per dollar expended, and it appears that these local needs are an important factor in the activities of the good roads work of the State. While it is to be deplored that the good roads movement is handicapped by the want of funds, it is possible that this handicap has been at least partially offset by the more careful study of the economic questions involved, made necessary by this shortage in funds. With the construction of our network of railways and ever increasing navigable waterways, the necessity for long, through line highways has passed; they are required neither for military nor commercial purposes; but the demand for more and better intra-community roads is becoming more insistent every day. The causes for this demand have been well stated in Mr. Kerr's paper and his later discussion.

CONTRACTORS' ORGANIZATION AND EQUIPMENT.

By
HAMPTON REYNOLDS.
(Read before the Society, November 9, 1914)

Organization.

This dual subject is so closely allied to another, i. e., finance, that it is hard to deal with one unless some consideration is given to the trinity which makes or breaks contractors; therefore, if I diverge somewhat from the subjects allotted, the reason will be understood.

It has been correctly stated that "organization in the contracting field presents two phases which often seem to greatly diverge. One, the possibilities in theory, and the other, the possibilities in practice."

One may theoretically plan a complete organization from his general superintendent to his water boy, and then, in practice, fail to get one of the proper units, either through his own lack of judgment regarding men or through his failure to make due allowance for the human element, or because the peculiarly adaptable men he desires are not immediately available. It is for these reasons that a grave doubt has arisen as to the efficiency of the old method of having a general superintendent who had sole authority over the details of each department.

Instead of this, it has been suggested that the entire work be subdivided into small units and a foreman specialist be employed for each unit.

This would seem to increase the cost of supervision, but my experience has been that the total resultant cost has been less, even with foremen with indifferent ability. In other words, where the number of men employed under one capable and high-priced foreman amount to twenty-five or thirty; if this gang were subdivided into smaller units even under less capable foremen, a decided reduction in the total cost was noticeable.

This subdivision should be so arranged and managed that one gang would never have to wait for another gang to do something, or for materials to arrive; they should always have more work outlined ahead each day than can be done that day.

There is a very important element to be taken into consideration in the employment of a large number of foremen, and that is, the seasons and corresponding weather conditions. This is particularly impressive if the foremen, as is customary, are paid running time.

From the foregoing, it is obvious that successful organization should be guided by a schedule of performance outlined in advance; but in making this schedule not only the weather, but other important factors, should be carefully considered, such as the price and availability of labor. For instance, some large contracts in certain localities themselves create a condition which tends to bull the labor market, besides other works being started after a contractor has started his contract may tend to increase the demand and, consequently, the price, and if knowledge could be obtained regarding this future work, then due provision should be made to overcome, in advance, this condition.

Reverting to the human elements reminds me of an incident that occurred to a contracting engineer. Seated in his office one evening, he was receiving over the phone reports from his superintendents and foremen on several different pieces of work, and after the receipt of each report the contractor would tell each man what he wanted him to do and how he wanted it done, but in no two instances did he use either the same intonation of voice or the same form of instruction. In one instance, it would be short, sharp orders; in another it would be soft encouragement; then, simple instructions; and so on through the whole play of the business stage. When this fact was commented on by a brother engineer who was present, and the contractor asked how it was that he did not talk to any of his men in the same way, his answer was simply, "No two men are identical."

This remark naturally leads into a discussion of the merits of piece work, task, and bonus systems, which I will not attempt to go into any further than to quote from Mr. Frederick W. Taylor: "There are two fundamental assumptions on which the layout of any extensive system of labor must be predicated:

"First. A man can do his theoretical best if continually instructed and coached, but not otherwise.

"Second. A man will do his theoretical best if adequately remunerated, and not otherwise."

And these assumptions are dependent upon the following assumptions as outlined by Mr. Taylor:

1. A large daily task that must not be impossible.
2. Standard conditions, so that work can be accomplished with certainty.
3. High pay for success.
4. Loss in case of failure.
5. The task set must be so difficult ultimately that none but a first-class man can do it.

My own experience has been that in the application of the above principles the workman has increased his wage anywhere from 30 to 100 per cent. with a corresponding decrease in the cost to the contractor as compared with the ordinary day labor system.

These percentages may seem high, but when the peculiarities of our local laborers are taken into consideration the reason is readily understood. This refers more particularly to the negro laborers.

A detail explanation of each of the aforementioned principles is, of course, impossible in this paper, but suffice it to say that if each contract is carefully studied and, where possible, these principles are applied, a very considerable remuneration will be obtained.

Equipment.

Some of the factors governing the selection and utilization of equipment are as follows:

Size and duration of the contract.

Availability of equipment, previously purchased on other contracts.

Capacity and weight of different machines with particular reference to the cost of moving and installation.

Careful consideration of the use of old machinery with the attendant high cost of repairs and maintenance as against the cost of new machinery.

It can be readily seen that on contracts of great magnitude the purchase of the proper kind of machinery for the work on

hand is compensated for by the cost being distributed over a large amount of work. This particularly applies where ample time is given for the completion of the work in view. However, where hurry-up contracts (and, I may say, most contracts are put in this category) are considered, the problem presents many phases. This applies, particularly, to the contract embracing various items of work.

The contractor first considers the adaptability of such equipment as he has in his possession and he is prone to utilize what he can even at an increased cost in production, and is very apt to fall into serious error on this account unless careful consideration is given to detailed first cost and ultimate operating cost and maintenance.

On the other hand, he may be imbued with prodigal ideas or influenced by consultation with his subordinates, so that he goes to the other extreme and abandons or sells machinery that could be changed at small cost and utilized to good advantage, and buys, instead, new and different machinery at a higher cost. I know of no set rule that can be followed in the solution of this phase of the problem, excepting experience and the careful analysis of each particular part of the work contemplated.

After the proper plant has been selected and installed, the next and most serious thing confronting the contractor is the working of every element of the plant to its capacity.

Some of the governing features are as follows:

Capable and sober operators.

Correct and detailed reports of the cause and duration of every delay.

Providing extra parts for the immediate replacement of broken or damaged ones.

Providing the proper kind of fuel and the regular delivery of same.

There are a great many other features too numerous to mention, and I will close by stating that my experience has been, that the unknown quantity is not so much the cost of doing work as it the cost of not doing it, i. e., delay, the *bête noire* of all contractors.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

REGULAR MEETING OF THE BOARD OF DIRECTION, JUNE 14, 1915.

The meeting was called to order with President Datz in the chair. Messrs. Coleman, Dusenbury, Williams and Hogg were present.

Minutes of the last meeting were read and approved.

A communication from the American Society of Mechanical Engineers in regard to their Transactions was read and referred to the Library Committee.

It was moved and seconded that the President be authorized to employ an auditor to audit the books of the Society if, in his judgment, the fee of the auditor was reasonable.

It was moved and seconded that the remuneration of the Editor of the Proceedings be fixed at \$300.00 per annum.

The following bills were approved for payment:

Searcy & Pfaff, binding magazines.....	\$ 6.25
Tulane University Press, printing and stationery.....	18.25
Wm. Frantz & Co., engraving two pins.....	.56
F. Daubert, refreshments May meeting.....	10.50

The following were approved subject to approval of Library Committee:

American Ry. Eng. Assn., Proceedings 1910 to date.....	\$33.50
American Society of Munc. Imprv., Proceedings 1910 to date.....	6.00
American Society for Testing Mat., Proceedings 1910 to date.....	29.60
American Inst. Electrical Engrs., Proceedings 1910 to date.....	23.00

There being no further business, the meeting adjourned.

W. T. HOGG,
Secretary.

REGULAR MEETING OF THE SOCIETY, JUNE 14, 1915.

The meeting was called to order with President Datz in the chair and thirty-four members and guests present.

Minutes of the last meeting were read and approved.

The Outing Committee reported that after consideration of all possible outings, the committee recommends that no outing be given this year. It was moved and seconded that the report be accepted.

It was moved and seconded that the Society adjourn for the summer months. The next regular meeting will be held in September.

The technical exercises of the evening were then held. Mr. J. P. Kemper read a very interesting paper entitled "A Paper Advocating a Spillway into Lake Borgne, below New Orleans, and an Increased Outlet Through the Atchafalaya, as a Means of Flood Relief in Louisiana." The paper was followed by an interesting discussion.

There being no further business, the meeting adjourned to the collation.

W. T. HOGG,
Secretary.

RECENT ADDITIONS TO THE LIBRARY.

Efficiency—Emerson.

Engineering of Shops and Factories—Tyrell.

Handbook of Construction Plant—Dana.

Highway Engineering—Blanchard-Drowne.

American Sewerage Practice, Vols. I, II—Metcalf and Eddy.

Smoley's Tables.

Structural Engineers' Handbook—Ketchum.

Proceedings of the American Railway Engineering Association, 1910 to date.

Proceedings of the American Institute of Electrical Engineers, 1910 to date.

Proceedings of the American Society for Testing Materials, 1910 to date.

Proceedings of the American Society of Municipal Improvement, 1910 to date.

Index to Proceedings American Society for Testing Materials, Vols. I to XII.

PROCEEDINGS
—OF THE—
LOUISIANA ENGINEERING SOCIETY

VOL. I

OCTOBER, 1915

No. 5

CONTENTS

EDITORIAL NOTES AND COMMENT:

	PAGE
A Much Debated Question.....	211
Delegates to the National Drainage Congress	212
Changes of Address.....	214
New Members	214

BOOK REVIEWS	216
--------------------	-----

PAPERS AND DISCUSSIONS:

A Paper Advocating a Spillway into Lake Borgne, below New Orleans, and an Increased Outlet through the Atchafalaya, as a Means of Flood Relief in Louisiana. <i>By J. P. Kemper</i>	220
Discussion	238

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY	279
---	-----

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SAMUEL YOUNG, Vice-President, 1002 Perrin Building.
E. H. COLEMAN, Treasurer, 920 Hibernia Building.
W. T. HOGG, Secretary, Tulane University, P. O. Station 20.

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W. B. GREGORY, Tulane University of Louisiana.
A. T. DUSENBURY, 901 Maison Blanche Building.
OLE K. OLSEN, 823 Perdido Street.

The headquarters of the Society are in the State Museum
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Address all business communications to W. T. Hogg, Secretary,
P. O. Station 20, New Orleans, La.

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PROCEEDINGS
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OCTOBER, 1915

No. 5

EDITORIAL NOTES AND COMMENT

A Much Debated Question.—In his paper read before the Society, June 14, 1915, Mr. Kemper has brought forward the oft-disputed question as to the best and most practicable method of controlling the flood waters of the Mississippi. He appears as an ardent advocate of the spillway and increased outlet policy as opposed to the so-called "levees only" policy. By way of introduction to the strictly technical portion of his paper Mr. Kemper proceeds to take to task the Mississippi River Commission and the various State Levee Boards for what he alleges is a spirit of prejudice on their part against any system of flood protection other than "levees only." He appears to assume that the engineers connected with these various organizations are so influenced by precedents and a spirit of case-hardened conservatism that they are individually and collectively either unable to appreciate the merits of any other system, or else unwilling to advocate any other system for fear of the falling of the official axe. It is to be regretted that Mr. Kemper has detracted from the value of his technical argument by bringing in these remarks, which, while expressed in somewhat impersonal terms, cannot fail of being quite personal in their application.

Copies of the paper were sent to the Mississippi River Commission and the courtesy of the pages of this journal was extended to the members thereof in case they should desire to discuss any of the propositions there set forth. Apparently none of them has cared to discuss the technical problem, but, pub-

lished elsewhere in these pages, is a communication from Mr. J. A. Ockerson, in which he explains and justifies the organization of the Mississippi River Commission, as well as the attitude it has taken in regard to the problem of flood control in the river below Cairo.

Mr. Kemper bases his technical argument for the spillway upon the two hydraulic principles that the velocity of flow is in direct proportion to the square root of the slope, and that the carrying capacity of a silt-bearing stream varies as the sixth power of the velocity. His further principal point is that the proper location for a spillway is below New Orleans and with an outlet into Lake Borgne. In his discussion of the paper Mr. Klorer brings out quite clearly the point that if we assume a silt-bearing stream which follows *strictly* the laws above enunciated, then the apparently logical conclusion would be that there would be no shoaling nor any decrease in cross-section below the spillway. Over against this, however, must be set the fact, based upon a large number of observations and surveys, that the river *does* shoal and the cross-section *does* decrease below crevasses and outlets.

If the laws are correct, and they are well accepted for ordinary conditions, then the facts with regard to the behavior of the Mississippi necessitate a search for conditions different from those under which these laws appear to be operative. Mr. Klorer makes the point here, as based upon the observations of Prof. Forshey and others, that the silt carried in *suspension* is small in amount when compared with the matter which is rolled or carried along on the bottom of the river, and that a large proportion of the shoaling is due to the deposition of this mass of matter, which apparently is not governed by the ordinary laws above stated.

Delegates to the National Drainage Congress.—It will undoubtedly be of interest to the members of the Society to know that of the nineteen delegates appointed by Governor Hall to represent the State of Louisiana at the Fifth National Drainage Congress, held in San Francisco during the past month, twelve

of the number are engineers, and eleven of these are members of this Society. The names of the delegates are given herewith:

A. M. Shaw, 2604 Calhoun street, New Orleans.

Wm. B. Gregory, 630 Pine street, New Orleans.

A. T. Dusenbury, 901 Maison Blanche, New Orleans.

Frank H. Waddill, 211 Camp street, New Orleans.

H. L. Favrot, 608 Hennen Bldg., New Orleans.

L. M. Pool, Hibernia Bank Bldg., New Orleans.

P. S. Schneidau, 203 Hennen Bldg., New Orleans.

John A. Kruse, 916-917 Hibernia Bank Bldg., New Orleans.

R. E. Milling, 619 Godechaux Bldg., New Orleans.

J. F. Coleman, 619 Godchaux Bldg., New Orleans.
Orleans.

A. Perrilliat, 819 Hibernia Bank Bldg., New Orleans.
Orleans.

P. M. Lamberton, 8310 Panola street, New Orleans.

F. Shutts, Lake Charles, La.

Ira W. Sylvester, Alexandria, La.

Warren B. Reed, Morgan City, La.

H. M. Pharr, Patterson, La.

Chas. A. McCoy, Lake Charles, La.

W. S. White, Crowley, La.

Frank M. Kerr, Chief State Engineer, New Orleans.
Orleans.

The composition of this delegation is noteworthy in the large number of engineers who are members. It is not at all unusual to see such delegations made up largely of lawyers, politicians and promoters, with a very small percentage of engineers. In the past the majority of engineers have been content to go along and do their special work, paying very little, if any, attention to the broader and more general aspects of the propositions, of which their own particular work was some fundamental and important part. Matters are beginning now to change rapidly in this respect, and engineers, both as a class, and as individuals, are beginning to realize that there is work for them beyond the mere technical details of the special job in hand. This is a day of increasing general interest in civic

problems, and there is no man better fitted by training and experience to pass competent judgment on many of these problems than the conscientious and experienced engineer. And when such men work together through an organization like the Louisiana Engineering Society, there is no limit to the amount of good they may do for the community in which they live. And as an organization we should leave nothing undone to increase and extend our influence in these directions.

Changes of Address.—Complaints come to the officers of the Society frequently from members who fail to receive their copies of the *Proceedings* regularly. This is due in practically every case to the fact that the member has changed his address and has failed to notify the Secretary. All members are specially requested, therefore, to notify the Secretary at once of any change in address.

New Members.—The following named gentlemen have recently been elected members of the Society:

RESIDENT MEMBERS.

C. Glenn Cappel, 104 Court Building, New Orleans; Engineer with State Highway Department, Board of State Engineers.

Frank A. Muthe, 2323 Short street, New Orleans; Assistant Superintendent in the Lighthouse Service.

Farrar P. Hamilton, 601 Interstate Bank Bldg., New Orleans; Paving Engineer for the Southern Pine Association, New Orleans.

Jackson W. Waters, 2611 Canal street, New Orleans; Land Reclamation and Drainage Engineer.

John A. Commagere, Jr., 1453 North Robertson street, New Orleans; with U. S. Government Engineers.

Charles H. Shapleigh, 1002 Q. & C. Bldg., New Orleans; Assistant Engineer, Assistant to the President, N. O. & N. E. R. R.

H. M. Harriman, 7920 Spruce street, New Orleans; General Superintendent New Orleans Gas Light Co.

Frederic N. Billingsley, Interstate Bank Bldg., New Orleans; with J. W. Billingsley, Contracting Engineer.

Lester F. Alexander, 834 Audubon street, New Orleans; Engineer and Contractor.

Schuyler P. Coleman, 1446 Nashville avenue, New Orleans; Reclamation Work.

J. L. Dickey, New Orleans; Engineering and Contracting.

James M. Geary, 707 Title Guarantee Bldg., New Orleans; General Contractor.

Edgar L. Stream, care Vaccaro Bros., New Orleans; Superintendent and Engineer of Steam Plants with Vaccaro Bros.

NON-RESIDENT MEMBERS.

Edward W. Bres, U. S. Engineers' Office, Q. & C. Bldg., New Orleans; with U. S. Engineers.

Fred I. Getty, Jennings, La.; manufacturer of Pumping Machinery.

A. Rogers Mielly, 908 S. P. Bldg., Houston, Texas; with The Hercules Co., Ltd.

JUNIOR MEMBERS.

Lucien J. Troxler, Jr., 516 Jena street, New Orleans; with Engineering Dept., United Gas and Electric Co.

A. M. Fromherz, 1133 Fourth street, New Orleans.

BOOK REVIEWS

The Regulation of Rivers. By J. L. VAN ORNUM. Pp. vii+393. McGraw-Hill Book Company, 1914. Price \$4.00.

The author of this book is Professor of Civil Engineering at Washington University, St. Louis. He was formerly a United States Assistant Engineer.

The book is a valuable contribution to the subject of river regulation, whether it be viewed as an economic problem from the standpoint of increased facilities for navigation, or as a public necessity in protecting from floods.

Theory and practice are both set forth in considerable detail. The book is intended as a text for engineering schools and for the use of practicing engineers, but it contains much that will interest the economist and the general reader. The style is clear and the information covers a wide field.

Chapter I treats of "Commercial Conditions" and starts with the assertion "Engineering works must be justified by their service." This is followed by a careful analysis of the conditions that have made railways pre-eminent in the field of transportation. Attention is called to the present status of river transportation in this country and to the fact that present conditions are not normal. The experiences of European countries are freely drawn from in the discussion.

There are chapters on General Phenomena; Investigations, Surveys, etc.; Methods of River Improvement; Principles of River Regulation; Work of Channel Construction; Protection of Erodible Banks; Dredging; Levees and the Control of the Current.

The book bears evidence of close study on the part of the author and of experience with the problems he discusses as well as an intimate knowledge of what has been accomplished in foreign countries.

Under the general subject of levees, the question is discussed at some length whether there has been a gradual rise of the beds of such rivers as the Mississippi, Po, Rhone, Seine, Rhine,

Elbe, and others; also the question of spillways or overflow reliefs, crevasses, etc.

Engineers in this section, all of whom have some interest in the subject of river regulation, because of the Father of Waters, will find this book full of interesting information.

W. B. GREGORY.

The Design of Steam Boilers and Pressure Vessels. By

GEORGE B. HAVEN and GEORGE W. SWETT. Pp. vii+416.
John Wiley & Sons, Inc., 1915. Price \$3.00.

The book is a well-written treatise for the designer. It deals with design only and does not go into the subject of operation. The authors are Professors of Machine Design at Massachusetts Institute of Technology.

The work is a carefully thought out exposition of the many and various factors necessary to the finished design of pressure vessels in general and steam boilers in particular; the latter mainly of the fire tube type. The design of water tube boilers is not taken up, the reason given being that the design of this type is largely the result of experience and precedent, rather than calculation.

The book is well illustrated by numerous cuts and inserts. The careful discussion of details, such as the designer would seek, is noticeable throughout.

The last five chapters are devoted to the actual design of several different boilers. Each design is divided into three parts, namely, specifications, statement of the problem, and the actual calculations of the finished design.

The presswork, in general, is excellent.

JAMES M. ROBERT.

Working Diagrams for Irrigation Engineers. By E. A.

MORITZ, Assoc. M. Amer. Soc. C. E. Pp. 395. John
Wiley & Sons, New York City, 1915. Price \$4.00.

As might be assumed by the title and as stated in the Author's Introduction, the major portion of the book is made up of tables and diagrams, the latter being used in most cases in preference to the former. The manner of presentation of hydraulic data and the reasons therefor are well described and stated in the following quotation from the introduction:

"Diagrams avoid mental interpolations; they throw vividly upon the mind a picture of how the different factors vary. Logarithmic scales are generally used for various reasons: First, they allow covering the greatest range of values in a given amount of space; second, on these scales the most of the curves are straight or nearly so, making the reading easier than where the lines are curved as on natural scales; from whatever part of the diagram a value is read, the same degree of accuracy is obtained, which is not the case when natural scales are used. . . . The diagrams give results that are well within the limits of accuracy of the data and at the same time avoid the implication of an accuracy which does not exist."

The selection of tables and curves is excellent for the use of the Irrigation Engineer and much of the matter will be found to be well adapted to the use of Drainage Engineers and those engaged in flood protection and allied work.

The author cannot be too highly commended for his frequent caution to the inexperienced that there are many uncertainties in matters hydraulic which are not susceptible of exact mathematical solution. The large number of actual examples showing the value of "n" under varying conditions should be of assistance in determining the value of this factor on new projects.

While the working tables appear to be well chosen and logically arranged, the same cannot be said of all the material which has been secured from outside sources; for example, Table 13, of "Maximum Rate of Discharge of Streams in the United States" gives the record of about 170 streams, one-third of which are located in the two States of New York and New Jersey, neither of which States is extensively interested in irrigation projects. A conscientious search of available data would have disclosed material for a more representative table.

An examination of available engineering literature and of many existing projects gives evidence of a woeful lack of thought given to the details of minor structures used in irrigation works. As constructed, they often indicate that their de-

sign has been left to an inexperienced assistant whose sole thought has been to produce something original. A discussion of the design of small structures, with detailed plans for their construction of concrete or creosoted timber would add materially to the value of the book.

The typographical work is good and the use of logarithmic platting has made it possible to extend the diagrams to reasonable limits without resorting to inserts, thus making the book convenient to handle and saving the diagrams from mutilation from careless folding.

ARTHUR M. SHAW,
Consulting Engineer.

Conservation of Water by Storage. By GEORGE F. SWAIN, Professor of Civil Engineering, Harvard University. Pp. xi+384. Yale University Press, New Haven, Conn. 1915. Price \$3.00.

The book is a collection of lectures delivered before the Senior Class of Yale Scientific School in 1914.

The first chapter is devoted to the general subject of Conservation. Attention is called to waste of resources in this country in many different ways. Losses by fire and the waste of fuels are especially emphasized.

The next four chapters deal with the conservation of water and the problem of Federal control of water power, with the legal technicalities involved.

Chapter six deals with the technical side of water development, while chapter seven is devoted to the much discussed question of the relation of forests to stream flow. The last chapter discusses floods and their control.

The book is written in an admirable style. The subject matter is presented in a most interesting and logical manner. Subjects that are intricate and involved are presented in a way that holds the attention of the reader. The attitude of the author is that of a seeker after truth who refuses to blindly accept the conclusion of others. He proceeds to gather facts, weigh the evidence and to draw his own conclusions. The book is a valuable addition to the literature regarding the Conservation of Water.

W. B. GREGORY.

PAPERS AND DISCUSSIONS

A PAPER ADVOCATING A SPILLWAY INTO LAKE BORGNE, BELOW NEW ORLEANS, AND AN INCREASED OUTLET THROUGH THE ATCHAFALAYA, AS A MEANS OF FLOOD RELIEF IN LOUISIANA.

By

J. P. KEMPER, C. E.

Read before the Society, June 14, 1915.

Mr. President and Fellow Members of the Louisiana Engineering Society:

I am before you, tonight, to read a paper advocating a spillway into Lake Borgne, below New Orleans, and an increased outlet through the Atchafalaya River, as a means of flood relief in Louisiana.

I realize fully that to a majority of the engineers here present such a policy appears to be heresy, and is repelled as unworthy of serious consideration.

There are others here, I believe, who have accepted the policy of "Levees Only" from the beginning of their careers, and have never considered the fact that serious thought and study might change their views. Perhaps they are afraid that it might.

I am inclined to think that there are yet others here who do believe that a modification of the levee system, along the lines which I will advocate, tonight, would increase protection from floods, but realizing the entrenched power of those now in control of the levee situation, they would prefer to remain quiet.

I am certainly hoping that there are some present who have ideas of their own on this subject, not dominated by the views of others, and will voice their ideas without reserve.

Precedent is innately a tyrant. Nowhere has this tyranny been more oppressive than in the levee system of the Mississippi river and its tributaries. It has balked every attempt to procure a demonstration of any modification of the levee system. Spillways, Outlets and Reservoirs have been advocated as a means of supplementing the levee system for many decades, but the point of trial is never reached. A free expression of opinion of any engineer on levee work, in any degree adverse to the present levee system would probably lose him his job. On the broad grounds that truth must eventually prevail, I hope and believe that this oligarchy will be smashed.

I shall endeavor, in this discussion, to steer clear of any theories not conformable to proved hydraulic principles.

My sole object is to be right, and not, simply, to be thought right.

It would please me greatly, if I could be led to believe that the present "Levees Only" system is correct in its application to Louisiana, because it is indeed serious to believe, as I do, that more than half of the flood plain of the Mississippi river is being jeopardized in order to maintain a system founded upon unsound engineering principles, and jealously defended by an autocratic power, inconceivable in a democratic country.

This power is the Mississippi River Commission, as dominated by its engineers, as a class; I simply mean to drive home this point: The Mississippi River Commission, created by Congress, in 1879, adopted a policy of "Levees Only" as a means of flood control, and, since that time, no one not previously committed to that policy could have secured a place upon the Mississippi River Commission.

By this system, there has been shut out that healthy, free competition of thought which makes for real progress.

Closely allied with the Mississippi River Commission are the Levee Boards of the various States, in the Valley, and their Engineering Sponsors. I believe that up to the present time, the "Levees Only" policy has so thoroughly dominated the various State administrations, that it would have been unsafe for the job of any State Engineer, or member of Levee Board, to lend his active approval to any other system of flood control than levees.

We have had many floods since 1879, notably in 1882, 1883, 1884, 1893, 1897, 1903, 1907, 1912, 1913. During the earlier of these floods, our levee system was incomplete. As time advanced, with great expenditures, both by the State Levee Boards, and the General Government, the levees were made much larger and stronger.

When the flood of 1912 came, our confidence in them was almost implicit. We had been led to believe that they were efficient in the highest degree; that the provisional grades had been almost attained, throughout the system. When they failed our disappointment was great. This disappointment becomes almost despair, when we read from the report of the Mississippi River Commission, for 1912, that the immediate causes of crevasses were defective foundations, sloughing, and, in only three cases, overtopping. The report goes on to explain that the defective foundations may exist far below the base of the levee, in strata of sand, through which the water percolates, and when the head of water in the river becomes sufficiently great, a break through the surface soil occurs, and the result is a sand boil, which may cause the levee to collapse with little or no warning.

The report further explains that sloughing is caused by the saturation of the levee, due to long continued exposure to flood waters.

Of the two evils, the latter is the lesser, because it can probably be overcome by increasing the cross-section of the levee. Unfortunately, some materials need greater cross section than others, and we generally find that out, after the levee breaks.

The defective foundations are far more serious, because we have 1500 miles of levees, and do not know where the bad foundations are.

Col. Sidney F. Lewis, in discussing the paper of Major Kerr, before this Society, stated that within the limits of this city, no longer ago than the 16th of February last, leaks developed in newly constructed levees, due to inefficient inspection of foundations.

Fortunately, there is not much water, this year, and when it recedes, the levees can be cut, and the defects cured.

It is a notorious fact that levee inspectors are not generally

appointed solely with regard to merit and integrity, and that our entire levee system is open to the dangers of unscrupulous inspectors and contractors.

This is not meant as a broadcast charge against inspectors and contractors, for many of them are honorable and efficient, but it is meant as an arraignment of the loose system in vogue.

Major F. M. Kerr, in his most interesting paper, read before this Society, on March 9 last, tells us that, in demolishing old levees, we are still finding fences, meat boxes, barrels, logs, etc., put there, evidently, to make yardage. He gives a graphic description of the negligence in building old levees, wherein no stumps were grubbed from the foundations. This, coupled with the startling revelation of Col. Lewis, which seems to indicate that conditions are no better now than then, makes the prospect anything but bright.

Now, I do not wish to be unfair, and I realize that human effort can never attain theoretical perfection. Other foundations than those of levees have given way; other inspectors and contractors than those on levee work have been dishonest.

The point which I want to emphasize is this: Even though we bring our levees up to the very latest adopted provisional grades, and increase the cross sections to the greatest practical limits, and revet the banks as well as it can practically be done, we are still liable to the dangers of bad foundations and of sloughing, and the higher the flood gets, and the longer it remains, the greater these dangers.

Now, suppose that by means of an increased outlet to the Mississippi, through the Atchafalaya, and a spillway below New Orleans, the flood stage throughout Louisiana can be so materially reduced that it will not be necessary to continually raise the grade, and to provide for continually increased pressure against the levees, causing continually increased danger from confessedly bad foundations, and from sloughing, should we refrain from adopting this plan through fear of discrediting the "Levees Only" policy, doggedly adhered to by the Mississippi River Commission, and echoed by the various State Engineering and Levee Boards, to whom the people are under no obligation beyond the salaries paid them?

I am appealing, to-night, to the young engineers; to those of you who have open minds, and propose to do some thinking for yourselves, and would like to see this problem solved, correctly, even though it upsets precedent of a hundred years.

Old, rusty, fallacious precedents are breaking down, every day, in every line of thought and action, and the day of the engineering fossil is at hand. The engineer who cannot make good with proofs of facts and results, in the face of opposition, belongs to the passing era, and must make room.

For this reason, I will put my proposition to you as clearly and concisely as possible, feeling sure that I will be met by arguments as frankly put as mine, and I promise you that I am open to conviction, and, if shown wherein I am wrong, I will be happy in the knowledge attained, for the subject puzzles me sorely. I am puzzled because I have been unable, from aught that I have read from the pen, or heard from the tongue of a "Levees Only" advocate, to find properly applied a single principle of hydraulic engineering. Invariably, the cart is placed before the horse.

The change may be at hand, and I look forward to it with great interest.

Let us treat the question of the spillway, first.

At a point about ten miles below Canal street, a short distance above Lake Borgne Canal, suppose a spillway be established by building two parallel levees from the river to Lake Borgne. Let them be the height of the river levees, at the river, with an uniform slope to Lake Borgne.

Next, remove the levee along the river, between the two parallel levees referred to above.

At an established grade, which, for convenience of calculation, we will fix at the elevation of the river water when the Carrollton gauge indicates 10 feet (this is in the neighborhood of bank full stage), we will build a concrete wall, of sufficient width and depth to fulfill the requirements, along the river front, from one parallel levee to the other. It will be attached, in a workmanlike manner, by means, probably, of concrete revetment, to the junction of the main and parallel levees, in order to withstand the heavy current at the entrance of the spillway.

Subject to a few details of construction, this completes the spillway.

At the 10 foot stage, about 710,000 cubic feet of water per second will be passing Carrollton. The velocity down the river, at this stage, is about 4 feet per second.

I shall endeavor to calculate a spillway that could take care of the flood of 1912, with a gauge reading not to exceed 16 feet at Carrollton.

Since no crevasse occurred below Red River Landing, until the crest had passed out to sea, the recorded maximum stages, from Red River Landing down, are reliable.

The Red River Landing gauge, in 1912, reached 53.2 feet, on May 11. The Carrollton gauge also reached its maximum of 21.05, on the same day. The greatest recorded discharge, at Carrollton, is 1,357,739 cubic feet per second.

On May 11, 1912, the average surface slope from Red River Landing to Carrollton was .192 foot per mile. If, by means of a spillway, the Carrollton gauge could be maintained at 16 feet When the Red River Landing gauge is 53.2 feet, the average slope would be .218 foot per mile.

Since the velocity varies as the square root of the slope, at any given point, maintaining the Carrollton gauge at 16 feet would increase the average velocity 6.6%. On the other hand, while it would not diminish the cross section, at Red River Landing, it would diminish the cross section at Carrollton by about 12,345 square feet, or a little over 6%.

If I understand this problem right, owing to the diminished cross section at Carrollton, the increase of velocity will be a gradual acceleration from Red River Landing, where the cross section is unchanged, to Carrollton, where it is diminished over 6%, and the net result will be a loss of a little over 3% in volume, due to diminished cross section, and a gain of 6.6% in volume due to increased slope, showing a net gain in volume of over 3%. This gain would have increased the maximum flow past Carrollton, in 1912, to about 1,400,000 cubic feet per second.

At a stage of 16 feet at Carrollton, about 1,042,000 cubic feet per second flows down the river to the Gulf. It is evident that the difference between 1,400,000 cubic feet and 1,042,000

cubic feet per second, or 358,000 cubic feet per second, must pass out through the spillway.

I freely admit that I am unable to accurately calculate how wide the spillway should be to accomplish this result.

The formula for water flowing over a dam cannot apply, because the dam being at about bank full stage, there is no clear air space under it. Cutter's formula for water flowing in open channels would not be correct, because the conditions are unusual. We have a shallow stream, wherein the wetted perimeter bears a high ratio to the cross section. On the other hand, the slope is increased to 20 times what it is in the river, and there is an acquired velocity, in the river, of almost 6 feet per second.

As a guess, I certainly would not expect the velocity to be less than what it is in the river, and it will flow 6 feet deep. This would require a width of approximately 10,000 feet, nearly two miles.

The physical difficulties accruing from the establishing of this spillway are trivial, compared to the benefits to be attained. The cost will be far less than that of continually raising levees. It would be necessary to purchase, or expropriate, about 6000 acres of land, of which 5000 is denuded swamp, and the balance, mostly farming land. It would be necessary for the Louisiana Southern Railroad to trestle through the spillway, and, likewise, the public road. I can think of no other difficulties.

There seems to be, among "Levees Only" advocates, a determination to locate prospective spillways where they will do the most damage, and to let them run wild like a crevasse, apparently with the avowed purpose of desolating the country. For example, Col. Lewis, in his discussion of Major Kerr's paper, seemed to infer that the reclamation projects would be destroyed, notably the Hero project. He also lays stress on fishing and bathing, in Mississippi Sound.

In dealing with spillways and outlets, it is supposed that the same good sense and judgment will be employed as in other great undertakings. The location of the spillway below the city would be correct, because it is only five miles to Lake Borgne, which is the open Gulf. Were it located at Bonnet Carre, and made to spill into Lake Pontchartrain, there is no doubt that,

owing to the restrictions to the outlet to Lake Pontchartrain, due to the Louisville and Nashville and Northeastern Railroads, and to the natural limitations of the Rigolets, the level of Lake Pontchartrain would be raised to a dangerous height before slope enough would be attained to take care of the spillway water. Furthermore, wasting this water into a reservoir the size of Lake Pontchartrain, would materially reduce the current, and cause the lake to fill up.

Now, let us, for a moment, deal with that most terrible of bugaboos, to which it makes one tremble to refer.

Major Kerr tells us that a spillway is but a crevasse in disguise; that a crevasse retards the flow of the current in the main stream, and that this retardation causes silting up of the channel, and an ultimate net loss in the flow. Mr. Gregory confirms his statement, and proposes to prove it by the fact that the ability of water to carry solid matter varies as the sixth power of the velocity. Double the velocity, and you increase the carrying capacity sixty-four times. Mr. Coleman confirms it by illustrating the Siamese twin effect of the Atchafalaya and the Mississippi, at Red River Landing. Mr. Klorer cites conditions in the vicinity of Donaldsonville to prove beneficial results from closing off Bayou Lafourche. All tending along the same lines: If you relieve the river of one drop of water, by letting it reach the sea by any other route than the Passes, you are punished therefor by the dropping of a grain of sand in the bed of the river, and the restricting of the channel that much. This is a sad predicament, if true. Hydraulicians tell us that the velocity of flow is in direct proportion to the square root of the slope, and I do not think that principle will be questioned; nor do I think there is any question of the correctness of Mr. Gregory's statement that the carrying capacity varies as the sixth power of the velocity.

Elaborate experiments by Mr. Forshey, covering two years, 1851 and 1852, as is recorded on pages 132 and 135 of Humphreys and Abbott's Report on the Mississippi river, showed that the water of the Mississippi was, at no time, charged to near its carrying capacity of solid matter, and the report goes on to say: "These observations demonstrate beyond question that no prac-

ticable high water outlet or waste-weir can occasion any filling of the channel by deposition of sedimentary matter, held in suspension by the water."

Now let us examine the actual conditions as they would exist in a spillway such as I have described.

Let us assume the river to be rising. At a stage of 10 feet on the Carrollton gauge, at the moment the water begins to flow through the spillway, the velocity of the water down the river is 4 feet per second, far more than is needed to carry all of the solid matter, and enough to roll along the bottom a rock containing 17 cubic inches.

Now, we are going to suppose that the river continues to rise until the Carrollton gauge reaches 16 feet. The water at the spillway will rise in identically the same proportion; the velocity of the water that continues down the river must increase as long as the river continues to rise, and when it reaches 16 feet the velocity will be 5.6 feet per second, and its carrying capacity of solid matter will be $7\frac{1}{2}$ times as great as it was at 10 feet. That is, it could roll, on the bottom, a stone containing 127 cubic inches, which is equivalent to a cube containing more than 5 inches on a side.

I contend that proponents of "Levees Only" must prove that the fact that a portion of the water runs out through a spillway exempts the remainder of the water flowing down the river from the laws which say that the velocity varies as the square root of the slope, and that the carrying capacity of solid matter varies as the sixth power of the velocity.

It would be most puzzling, if it were not so ridiculous, that these two fundamental laws can be so glibly used to prove the very proposition which they disprove.

This is the crux of the question. Their contention is wrong, or the laws are wrong.

If the river can carry all of the solid matter, when the velocity is 4 feet per second, why can it not carry it when the velocity is 5.6 feet per second, and its carrying capacity of solid matter $7\frac{1}{2}$ times as great as it is at 4 feet per second?

Humphreys and Abbott solved that question to the satisfac-

tion of any thinking man. They proved all that I am contending, and yet they are quoted to disprove these very principles.

They went into the question of outlets and spillways, exhaustively, and what conclusions did they reach?

First, as regards outlets, they said that none were practical above Red River Landing, because, while they would undoubtedly be most beneficial to the river, the problem of disposing of the water, after taking it out of the river, would be more difficult than holding it in the river, between levees.

In this I heartily concur.

They examined Bayou Teeche as a possible outlet to Red River, through Bayou Courtableau, and condemned it as too insignificant to be of any material benefit. Likewise, they condemned Bayou Manchac for the same good reason.

When it came to Bonnet Carre, they showed most conclusively that no deterioration of the channel had accrued from the various crevasses at that point, and that the crevasses did relieve the river, but they also showed the unfeasibility of turning the water into Lake Pontchartrain. In this I also concur.

They also examined the Lake Borgne situation, with a view to an outlet, and the only objection raised was that Lake Borgne, being shallow, would fill up, to a considerable extent.

The report concludes the Lake Borgne discussion with these words: "If outlets are to be used, however, this is the locality for their trial, since the results would be less injurious, here, than at Lake Pontchartrain."

I freely admit that Lake Borgne will fill up to some extent, but I believe a channel will wash out to deep water. I also believe that, during the spring, when a great flood is on, bathing on Mississippi Sound might be slightly affected, and it may be that the oysters in that vicinity will have to pick up their beds and walk, but I believe that the protection of New Orleans, and the rest of the flood plain of Louisiana, is more important than either of these contingencies.

Supposing that thus far my deductions are correct, I have shown how a spillway 10,000 feet wide, into Lake Borgne, could provide for a flood 3% greater than that of 1912, with a maximum stage of 16 feet at New Orleans, instead of 21.05, as was

the case in 1912. It would also lower the flood stage at Baton Rouge 1.8 feet, at Donaldsonville 3.1 feet, and at all other intermediate points in the same proportion.

These figures suppose that a maximum flood is maintained, which will hold Red River Landing at a stage of 53.2 feet. Of course, with a spillway, this condition will not exist. As soon as the river passes the 10 foot stage at Carrollton, water begins to flow through the spillway. This will cause the Carrollton gauge to rise more slowly than formerly, in proportion to the rise at Red River Landing. This will maintain a greater slope than formerly, and, consequently, a greater velocity.

It is now that the real good is being done, getting rid of the water in advance of the crest, holding the lower river down to a lower stage, thereby creating a greater slope and consequent velocity, and having a storage room in the river for a portion of the flood, while the remainder is getting out.

Just how much this benefit will be is hard to calculate. In 1912, water would have been running through such a spillway for three months before the crest of the flood. The river would have cleared itself of a great volume of water in advance of the crest, and made room for more. The crest would necessarily have been lower at Red River Landing, how much I cannot say with accuracy, but surely enough to be of great benefit.

I wish to make one slight concession here. In the event of a spillway, I believe that owing to unbalanced pressure, due to the water being relieved on one side of the river, there will be a tendency of the river bed to deflect towards the spillway. If permitted to do so, it would scour on that side, and fill on the other, always maintaining, however, an equal cross section. Depositing occurs only in practically dead water, and is a consequence of scouring, and scouring is not a consequence of deposit. Owing to centrifugal force, the river scours on the outer bank of a curve. The water travels much faster there; in fact, it robs the inner bank of practically all of its velocity, and causes deposit. It is an assured fact, however, that there is always as much scouring as there is depositing. The river never voluntarily diminishes its capacity. Before we had levees, it acquired

cross section by overflowing its banks, now it breaks through the levees.

An Increased Outlet Through the Atchafalaya.

Fifty years ago, not more than 120,000 cubic feet of water per second passed down the Atchafalaya, at flood. In 1912, about 250,000 cubic feet per second was passing down, when the levees began to break, and at the crest of the flood, over 400,000 cubic feet passed Simmesport. Of course, much of that passed out through the two crevasses, one on each side of the river, below Melville.

As presently leveed, probably 300,000 cubic feet per second can flow down the Atchafalaya before the levees break, which will occur probably before Red River or Barbres gauge reaches 50 feet. In 1912, the first break occurred when Barbres gauge reached 44.80, and in 1913, when the Barbres gauge reached 47.40. The levees have been improved, on the Atchafalaya, since then, and could now probably withstand near 50 feet at Barbres Landing. In the past 18 years, the Barbres gauge has exceeded 50 feet four times.

To have withheld the flood of 1912 would have required that the levees on the Atchafalaya withstand 52 feet on the Melville gauge. This is 10 feet higher than the track of the Texas and Pacific Railroad was at that time. Since then, the bridge has been raised 3 or 4 feet, but is still far too low to afford reasonable protection.

The cause of this deplorable condition on the Atchafalaya is not hard to find. The volume of flow is directly proportional to the product of the cross section and the square root of the slope. Owing to the nature of a delta forming alluvial stream, the cross section and slope are both greatest at its effluence from the parent stream. Further down the stream, the deficiency in cross section and slope was formerly overcome by overflowing the banks, and putting out subdistributaries. In leveeing the Atchafalaya, the subdistributaries have all been cut off, and the river has been leveed to prevent the overflowing of the banks; still the levees are neither high enough nor strong enough to add the necessary cross section to compensate for the loss. Now, my contention is, solely, that it is far more feasible to increase the cross section

by setting the levees back and permitting the low, valueless swamp to remain within the river, than it is to maintain the levees on the banks of the river, and cut off all subdistributaries, especially below the Frisco Railroad, where there is almost no cultivable land along the banks of the river, and where the subdistributaries are continually growing larger, and the main river smaller. For instance, Alabama Bayou was half as large as the Atchafalaya itself. The diking of it simply meant the reducing of the cross section one-third. This required an increased slope to overcome this loss. The only way to get this increase of slope is by raising the surface of the river above the dike. It was necessary to raise the slope in the immediate vicinity of the dike about 75%. Not being provided for by the strength and height of levees, the results were, and still are, disastrous.

It is my firm conviction that if the Alabama dike were removed, and the levees made to conform to the rule stated by me above, namely, that the product of the cross section and the square root of the slope, at any point in the stream, must at all times be at least equal to the product of the cross section and the square root of the slope, at all points above, the Atchafalaya could easily be made to carry 400,000 cubic feet per second, when the Red River Landing gauge registered 50 feet.

This would be of enormous benefit to the Mississippi, relieving it, at flood, of probably 150,000 cubic feet per second more than at present, and this would necessarily lower the flood stage several feet.

The Atchafalaya swamp comprises, probably, 1200 square miles, bounded on the east by Bayou Lafourche, and on the west by Bayou Teche. It is an effective storage basin, and by holding back a large part of the flood waters, materially aids the lower Atchafalaya, from Morgan City to the Gulf.

During recent years, since more water is coming down the Atchafalaya than formerly, and breaks in the levees are more frequent, the back water along Bayous Teche and Lafourche, from the Atchafalaya swamp, is becoming more formidable during each flood. I was glad to see that, last year, the Atchafalaya Levee Board committed itself to the protection levee system, which simply means the setting back of the levees to

the margins of the cultivable lands, and permitting the swamp basin to receive the alluvium, and be built up for the use of future generations. These protection levees can be made of much benefit to a large territory within the basin. They cannot, however, be made to benefit, to any large extent, the lower margin of the basin, owing to drainage troubles, and the proximity of the land to the Gulf level.

I am an ardent advocate of a plan which can be of an enormous benefit to the Atchafalaya Basin, and overcome any possible objection to deflecting more Mississippi water through the Atchafalaya.

This plan consists in cutting an outlet from Grand Lake, at Charenton, into Cote Blanche Bay, using Bayou Teche as a channel for four miles of the total distance of thirteen miles.

Such an outlet, with a width of 1000 feet and a depth of 20 feet, could easily discharge 100,000 cubic feet per second, at a stage, at Charenton, of 8 feet above mean Gulf. This stage would be low enough to have all of the present private protection levees back of the plantations, in St. Mary Parish, on the east side of Bayou Teche, effective.

It would be required to so regulate the intake, at the head of the Atchafalaya, that the present outlets at Morgan City and Bayou Boeuf, supplemented by the proposed cut at Charenton, could readily take care of the surplus water deflected from the Mississippi, through the Atchafalaya.

This is no monumental engineering problem, and involves no principles not already thoroughly understood.

The policy of confining the levees to the banks of the Atchafalaya can lead to but one thing, and that is failure, exactly as was the case on Bayou Lafourche.

At the March meeting of this Society, Mr. Shaw referred to the failure of the levee system, on Bayou Lafourche, but, as is always the case with "Levees Only" advocates, he missed the correct solution. Notwithstanding the statement to him by certain dredging crews, that, after crevasses on Bayou Lafourche, it took months to dredge out the bars formed in the channel, immediately below each break, the exhaustive investigations by Humphreys and Abbott, on Bayou Lafourche, proved conclusively

that such was not the case from early crevasses. The bed of the bayou failed to show any such deposit. The real cause of the failure of the Lafourche levee system was exactly the same as that which is now causing the failure of the Atchafalaya levee system. The cross section, below Lockport, was hardly half what it was at Donaldsonville, and the slope was also less.

To effectually levee Bayou Lafourche would have required that the levees be higher, the further they were extended, always maintaining the product of the cross section and the square root of the slope at least equal to that at any point above.

The cost of this was prohibitive, hence the necessity of diking Bayou Lafourche.

As a way out of the Atchafalaya dilemma, it is proposed to dike it off, at Old River. That such a policy would be suicidal is evident. The first objection is that the Atchafalaya Basin would then have to receive all the crevasse water from any crevasse which might happen on the west side of the Mississippi, from the mouth of the Arkansas to Donaldsonville. An examination of the frequency of past crevasses will show that that objection, alone, would be sufficient to depopulate the entire basin.

During the flood of 1912, on April 12, there was flowing through Old River, from the Mississippi towards the Atchafalaya, 347,229 cubic feet per second. A portion of this was going to fill the Concordia basin, but at least 250,000 cubic feet per second was passing down the Atchafalaya. Had the Atchafalaya been divorced, at that time, it would have added 16% to the flow down the Mississippi, at Red River Landing, which would have raised it probably 7 feet.

The return of crevasse water from the Tensas basin diminished this flow, and on April 29 it was entirely overcome, and the flow changed towards the Mississippi.

On May 1 the Torras Crevasse occurred, which solved the problem of what to do with the surplus water, held there because it had no adequate channel through which to flow to the sea.

In controversion of the statement of Mr. Coleman, in discussing Major Kerr's paper, and referring to the Atchafalaya, to the

effect that as the capacity of the Atchafalaya increases as an outlet to the Mississippi, the capacity of the Mississippi decreases in the same proportion, I beg to refer him to the facts in the case which show that, during the flood of 1912, almost a million and a half cubic feet per second flowed down the Mississippi, at Red River Landing, far more than ever before. Likewise New Orleans got more water than ever before, and in the same proportion.

Referring to Mr. Klorer's statement that the closing of Bayou Lafourche improved the capacity of the Mississippi river, and that Donaldsonville and College Point now show from 6 to 8 tenths lower for a given gauge reading at Baton Rouge, than they did prior to the closing of Bayou Lafourche in 1904, let us examine this closely.

First, I think he is mistaken in saying that Bayou Lafourche ever discharged from 35,000 to 40,000 cubic feet per second. I do not think it ever discharged more than 11,000 cubic feet per second, except, perhaps, during a crevasse. Its total output was, probably, never as much as one per cent of the capacity of the Mississippi river.

I have selected a number of maximum gauge readings, at Baton Rouge, Donaldsonville and College Point, both before and after the diking of Bayou Lafourche in 1904, and find the following relative conditions to exist:

In 1884, Baton Rouge reached 36.20, Donaldsonville reached 29.95, and College Point reached 24.10. In 1909, Baton Rouge reached 36.17, practically the same as in 1884, Donaldsonville reached 28.65, and College Point reached 24.40.

So, in 1909, Donaldsonville was relatively 1.27 lower and College Point .33 higher than in 1884. If there is anything in Mr. Klorer's contention, both should have been lower. It is probable that crevasses, in 1884, caused this unexpected variation, and the figures are valueless to prove either contention.

Again, in 1894, Baton Rouge gauge reached 30.95, Donaldsonville 24.35, and College Point 20.55. In 1910, Baton Rouge reached 29.50, Donaldsonville 23.00, and College Point 19.40. In this case, Donaldsonville showed a stage relative to Baton Rouge one-tenth higher in 1910 than in 1894, and College Point three-

tenths higher. This does not help Mr. Klorer's contention any.

Again, in 1897, Baton Rouge gauge reached 40.65, Donaldsonville 32.75, and College Point 27.95. In 1908, Baton Rouge reached 39.60, Donaldsonville 31.60, and College Point 27.19, showing a relatively lower stage, in 1908, for Donaldsonville, as compared to Baton Rouge of 0.2, and a relatively higher stage at College Point of 0.29.

From the above, it is evident that Mr. Klorer cannot bear out his contention by the gauge readings. His arguments are nullified, and yet, such statements go out with the authority of his high position, and mould the public mind along erroneous lines.

In refutation of the statement so frequently made by "Levees Only" advocates, that crevasses do not lower flood stages, I wish to call attention to the flood of 1882, probably the greatest known. The maximum gauge reading at New Orleans was 14.95, more than six feet lower than in 1912.

To what could this difference be attributed except to the crevasses in 1882.

In conclusion, let me emphasize the following salient facts: Half of the flood plain of the Mississippi river is in Louisiana. Below Red River Landing, the river is smaller and the slope less than anywhere up to Cairo. At Columbus, Ky., the flood capacity is more than 2,000,000 cubic feet per second, at Red River Landing 1,500,000, and at New Orleans, 1,300,000. Were it not for the storage capacity of the river to absorb this surplus of capacity of the upper river, it is evident what the consequence would be.

Thus reviewing the case, is it not highly desirable that the capacity of the river from Red River Landing down be increased as much as possible? This would maintain the river at a lower stage, increase the slope and consequently the velocity. It would reduce the pressure against the levees and minimize the danger from defective foundations.

If the plan is practicable, I do not see how the advisability can be questioned.

It all hangs upon whether or not the capacity of a river is diminished by deposit, below a spillway or an outlet. I have

heard it asserted a thousand times that it is, but all the definite information that I have been able to get on the subject goes to show that it not only is not so, but, from the fact that the river is never charged with solid matter to its carrying capacity, and the velocity varies as the square root of the slope, and the carrying capacity varies as the sixth power of the velocity, it is absolutely impossible for a spillway to cause any impairment of channel. The river is carrying its solid matter all right when the water begins to flow through the spillway, and at all times thereafter, until the crest is reached, the velocity is continually increasing immediately below the spillway, due to the increase of slope. On a falling river, the condition is reversed. When the water ceases to flow through the crevasse, there is still the same velocity due to that stage of the river, and if it carried the solid matter before, why can it not carry it now?

If there is any difference in the action of an outlet like the Atchafalaya from a spillway, I would expect it to be at low water, and not at high water. I could conceive of the idea that the slope being so much greater through the Atchafalaya than the Mississippi, it would rob the Mississippi, at extreme low water, of most of its current, and thereby cause deposit, were it not for the fact that Red River about supplies the Atchafalaya, at low water.

It is easy to understand why Old River silts up. It seldom has much current, and is absolutely dead water several times each year. This is a slight impediment to navigation, but it surely would not warrant so monstrous a blunder as divorcement of the Atchafalaya from the Mississippi.

Discussion Upon "A Spillway Into Lake Borgne."

THE PRESIDENT: You have heard Mr. Kemper's paper. I am sure we all enjoyed it, and we should be indebted to Mr. Kemper for a very interesting paper. He has had something to say, so has volunteered to give us this paper, and I believe we ought to be very grateful for it.

MR. COLEMAN: I move that a vote of thanks be extended to Mr. Kemper.

The motion was duly seconded.

THE PRESIDENT: All those in favor of this motion will signify by saying aye. The motion is unanimously carried.

THE PRESIDENT: I would like to say that I was looking forward to a vacation for the Society for a month or two, but I believe that there are so many of the men believing in levees who have been adjudged wrong in their belief that they will want an extra meeting or two to discuss this paper, to set themselves right.

MR. COLEMAN: In connection with this paper, and in advance of the discussion which will no doubt be precipitated at once, I would suggest that there is no more important question before the citizens of the Mississippi River Valley than the question which is raised in Mr. Kemper's paper, and that it would be wise for the Louisiana Engineering Society to have the members write out their discussions of the paper, which may be more readily prepared after the reading of Mr. Kemper's paper, than after hearing it read, or from such understanding of it as we gather in listening to it. My suggestion therefore is that the discussion be not concluded to-night with a verbal discussion, but that written discussions be submitted, to be published in the journal at the same time that the paper is published.

THE PRESIDENT: I think that's a very good point, Mr. Coleman. Do you make it as a motion?

MR. COLEMAN: If you think a motion is necessary, I will so move.

THE PRESIDENT: The custom has been that we have discussed papers recently at the same time they are read so that

another paper can be read at the next meeting, but in view of the important subject, I think it would be wise to adopt this suggestion, and to have our next meeting devoted entirely to the discussion of this paper.

MR. COLEMAN: My suggestion was that the discussion not close to-night, but that anybody who might care to discuss it in writing should be privileged to discuss it in writing, and submit his written discussion to be published simultaneously with the paper in the next issue.

MR. ANDERSON: I think it would be advisable to have Mr. Kemper's paper printed at an early date, and copies distributed to the membership, so each man would have a copy before him in the preparation of his discussion. Such discussions might be presented at a subsequent meeting of the Society, or they could be communicated in writing for publication in the *Proceedings*. I think it would be possible to have the paper printed within a few days, and distributed to the members.

THE PRESIDENT: That's a very good suggestion. The paper is to be set up for the journal, and might be set up in the next few days, and sent out. It's just a question as to whether the members would want to have another meeting set aside for additional discussion on this paper or not, but I agree that your suggestion to mail the paper to each member and invite written discussion instead of an extra meeting is better.

MR. LEWIS: I would like to ask Mr. Kemper how many cubic feet per second he intends the spillway to take care of?

MR. KEMPER: Three hundred and fifty-eight thousand cubic feet.

MR. LEWIS: He spoke of a theory. I want to remind him of the Nita crevasse. It took care of 402,000 cubic feet per second and yet the effect on the gauge at College Point was to lower it only 1.5, and the gauge at New Orleans, .4. Is not that a spillway in itself? It was acting as a natural spillway. Is that a theory? These are absolute facts. The Nita crevasse, in 1890, was at its incipency on March 22. Eight days after the crevasse broke, Nita crevasse took care of 9,000 cubic feet per second. On the 22nd of May, when the crest was reached on the Mississippi, the Nita crevasse took 402,000 cubic feet

per second, about one-third of the discharge of the Mississippi at the time. There has been a lot of talk of theories on the Mississippi River, referring to spillways, but these are facts that we can talk of.

MR. KEMPER: A crevasse comes generally just about, or probably a little in advance of the crest of a flood. The water has been accumulating and constantly rising and every effort has been made to hold the levees intact, up to the very last, just as you were doing at Bayou Sara during the flood of 1912. (I happened to be there, after that levee gave way, and stepped from a skiff to the second story of the hotel.) Well, now, they held it, and held it, and held it, but finally it broke. Now, the first effect, after the break, is to lower the water at the crevasse, and to increase the slope immediately above the crevasse, very much, and the water comes with a terrific rush. This slope, however, adjusts itself on up the river until it is not so noticeable; nevertheless, if the crevasse is putting out 400,000 cubic feet per second, there will certainly be flowing down the river as much water as was flowing down before the crevasse, and there will be a relief to the river amounting to 400,000 cubic feet per second, due to the crevasse. After holding the water so long, until the gauge gets so high, it is unreasonable to expect the crevasse to pull it down in twenty minutes.

If there was a spillway below New Orleans, you would have got rid of that water before the crest came. Now, as it was, the Torras crevasse lowered the crest 1.3 feet, but it took eleven days to do that, but had you had a spillway operating there from the time you got the banks full, the river would have been relieved of so much of its stored water that probably the crevasse would not have happened. I simply mention this to emphasize my point, because I don't advocate a spillway at this place. I say the only practical place for a spillway is down here at Lake Borgne, for the reasons that I set forth in my paper, but that must operate in advance of the crest, in order to maintain a low river stage down here, where the cross-section is so little, and the slope is so little, so as to have some increase of slope, and the way to do that is to have the water begin to flow out long before you get to the crest, and not to wait for

the levee to break; then the damage is done. But mark what I say: just as much water goes down the river during a crevasse as went down before the crevasse for the same stage. If the gauge was at 35 feet, before the crevasse, and went to, say, 36 or 37 feet, and then the crevasse occurred, and pulled it back to 35 feet, then, as much water was going down the river as when it was at 35 feet before the crevasse. Now, if you will prove me different, just let me ask you why?

MR. LEWIS: The river rose from March 22 to May 22, and on May 22 there was an exit of water of about 700,000 cubic feet, including the 402,000 at Nita crevasse. Yet the flow passing Red River Landing was about 1,200,000, and only 987,000 cubic feet per second passing New Orleans on the same day, with no inlets anywhere between Red River and New Orleans, and Bayou Lafourche drawing off 30,000 cubic feet per second.

MR. KEMPER: It was 1,200,000. There is always more at Red River than at New Orleans.

MR. LEWIS: Between Red River Landing and New Orleans there were eight or ten other crevasses taking care of about 700,000 cubic feet per second, including the Nita crevasse.

MR. KEMPER: Yes, sir. There were the 2,000,00 feet, and 100,000 going out through the outlet.

MR. LEWIS: Discharge observations on May 22 showed 980,000 cubic feet per second at Carrollton.

MR. KEMPER: There must be a spring in the bottom of the river—

MR. LEWIS: These are the problems of the Mississippi; there are too many variables to limit the estimation of the flow to a specific formula.

MR. KEMPER: I will not discuss that; it is too impossible.

MR. COLEMAN: I have known Mr. Kemper for many years, and I feel perfectly safe in making the assertion, with no question in my mind as to its accuracy, that Mr. Kemper is just as earnest in his search for the truth as are the others of us who have studied this question. I don't think that Mr. Kemper has been quite so generous in his consideration of the conclusions reached by other engineers whose conclusions differ from his own in that particular respect. He seems to have assumed in

his paper, that all those who entertain different opinions than those which he espouses must necessarily have jumped to those conclusions just to obtain jobs or to hold their jobs, or through some other like means. Now, if I have been guilty of reaching my conclusions by any of those several routes, I am perfectly free to confess that I didn't know it myself. I am just as earnest in my convictions and just as earnest in my beliefs on the other side of this question, as I believe Mr. Kemper to be on his side of the question. Mr. Kemper, in his discussion of the situation at the Atchafalaya River, has raised what seems to be a most interesting phase of this question, and this place affords more interesting information than almost any other place I know of. Mr. Kemper on this question has assumed, has stated rather positively, that the presence of the Atchafalaya as an outlet, in no manner could or would deplete or depreciate the main stream of the Mississippi River below that outlet. Now, I could speak of what the official records show prior to my personal acquaintance with it, but I will refrain from doing that. I, personally, had charge of some observations for the United States Government on the Atchafalaya River, on the Red River, and on the Mississippi River just below the Old River (the outlet) at Red River Landing in 1889 or 1890, I don't remember the exact year—I think it was in 1890—but I do know the situation at that time from my personal and repeated soundings day after day covering a period of something like six or seven months. I want to say that the Mississippi River at Red River Landing at that time was thirty-five to thirty-seven feet deep at low water in the channel. I do not have in mind at the moment the exact figures representing cross-sectional area and depth at the present time because I did not refresh my memory on this point to-day, but I do know that in 1912, the river, which averaged 35 to 37 feet deep at low water in 1890, was so reduced in its cross-section that the deepest water was about seven feet on the same section lines. Now, the shoaling of the stream at that point did not exist merely during low water, nor was it a condition which had been brought about in any revolutionary manner. It was a gradual change, and to my mind there is no satisfactory explanation

that can be offered, excepting that it is the result of a checking in velocity of the main stream due to the outlet, and a consequent deposit of material which has reduced the cross-sectional area of the stream. Now, either these are facts, or I am mistaken, because I, personally, made my soundings and I made them over and over again during the period, not of a day, or of a few hours, or of a few days, but covering a period of months, and I know those to be absolutely true statements. If there is any other way in which the shoaling of the stream at that point may be accounted for by any usual laws, it is a way that I have not so far been able to find. The only laws that I know of that have affected the situation at that point are the laws which Mr. Kemper has cited to-night.

It seems to me that Mr. Kemper has perhaps lost sight of the fact that while the river at a given velocity is capable of carrying a given amount of silt, that at higher velocities it carries larger amounts of silt in the proportion which has been mentioned, and that every time the river itself acquired any accelerated velocity it picks up quantities of silt to the limit of the capacity which that increased velocity gives it. If the amount of silt that the river happens to be carrying at a velocity of six feet per second is a given percentage, and you check the velocity to four feet per second, there is going to be a settling down or deposition of the silt. This happens whenever a retardation of velocity takes place, and it does happen whenever any part of the main stream is diverted from the main channel. I think that Mr. Kemper would probably admit that the withdrawing from the main stream of any considerable quantity of water unquestionably does have a retarding influence on the velocity of the main stream, checking the velocity of the main stream at that point; and if it does check the velocity of the main stream, which I am certain is true, it does create a deposit; and if it does do that, whatever the cause may be, the deposit forms a restriction or construction in the main channel. Now, I was perfectly open and free in my own mind on this subject; had no beliefs or opinions one way or the other in favor of the levee system or of the outlet system; in fact, I had given the matter no thought or study or consideration whatsoever until

in 1890, or thereabouts, when I was assigned to the duty of making the gaugings of the Mississippi, Red, Atchafalaya and Old Rivers for the Government. The duties of my position occupied a comparatively small proportion of my time, perhaps four to five hours a day; and while I am to some extent lazy, as most people are, I could not find myself satisfied to remain idle the remainder of those long days. There was no amusement at Red River Landing to afford opportunity for a man to pass his time agreeably except in study, and at that time, I obtained copies of publications of all sorts and character dealing with this problem. This was my start, and I began my studies with just as earnest a desire to arrive at some true and just conclusion with respect to the facts of this great problem as did Mr. Kemper. I had no wish or desire at that time, and never had before that time, and never have had since that time, to work for the United States or for the State of Louisiana any longer than until I could get another job somewhere else. I would not have stayed in the employ of the Government if they guaranteed me a life job, unless it was impossible for me to obtain any other position. Therefore I had no such incentive to lead me to a conclusion as Mr. Kemper has charged against most of us who do entertain this conclusion, and so far as being mercenary is concerned, I do not think Mr. Kemper's suggestion is justified.

MR. KEMPER: I just want to square up one little point. I divided the matter up into several classes, and Mr. Coleman has no right to place himself in the class of a man who expected to hold his job. I give him credit for being a man of great freedom of thought, and in fact, I framed that paper so that it would not tread on personal toes, but I do think the Mississippi River Commission is an autocratic board, committed to levees only, and that they do not give the other side a square deal. Now, I certainly made no personal allusions to any engineer here or elsewhere, but I do criticise the organization of the Mississippi River Commission. I hope that no one will take any personal exception to anything which I have said to-night. Now, as regards Red River Landing, I am not as familiar with conditions up there as I would like to be, and I am

not as familiar, I am sure, as Mr. Coleman is, or at any rate, was in 1890. I would like to ask him if the levee at that time ran around Raccourcei Island as it does now?

MR. COLEMAN: No, sir; the levee at that time was on the banks of the river.

MR. KEMPER: I want to offer this suggestion. I want to know about the cross-section below Red River Landing in 1912—

MR. COLEMAN: The levee was about fifteen hundred feet back of the old Mortimer store at Red River Landing. It passed in front of the store just above that.

MR. KEMPER: Well, this is the suggestion that I would like to make, and I don't make it as any positive reason, because I am not sufficiently familiar with the subject. But below Smithland, where the levee follows Raccourcei Old River, the flood cross-section becomes enormously greater than it is, say, at Angola, or just at Red River Landing, due to the fact that the river is about ten miles wide, I guess, there. The cross-section is probably eight hundred thousand square feet or a million square feet instead of two hundred thousand, and the flood width of the river around it is mostly over banks. The average cross-section of the river, I mean. I should certainly believe that, coming into such an enormously increased cross-section, the flood might cause a tendency for the river to fill in the neighborhood of Red River Landing, or just below it. I don't know exactly where the filling is that you refer to.

MR. WADDILL: I know that the sand bar that Mr. Coleman seems to refer to terminates in the vicinity of Smithland Landing which you describe. The sand bar that Mr. Coleman refers to is easily followed up at the time Mr. Coleman was there, but not at the present time, when it sticks up about five or six feet below the usual gauge. The channel that Mr. Coleman has described there on either side of the river does not exceed ten feet.

MR. KEMPER: Mr. Waddill, what is the cross-section of the river at the point where the bar is?

MR. WADDILL: I could not say.

MR. KEMPER: Is it not in excess of two hundred thousand square feet?

MR. WADDILL: Well, at Red River Landing down to Smithland, where the cross-section does not vary very much, but below Smithland it swings off to the right of Raccourei Lake; up for two or three miles, the cross-section does not change very much there, especially around the bar there.

MR. KLORER: This is the age of insurgency, and it appears that we have insurgents in the Engineers' Society as well as in other societies. I, for one, am glad that we have insurgents, for the conflict of opinion, on different sides of the same question, is going to assist us in arriving at the truth. I want to say, as one of the parties under fire, that I would much prefer to answer in writing the assertions made by Mr. Kemper. I think that we cannot very well deal with a mass of gauge readings, and keep them clearly before our minds, unless we have them before us in writing. Therefore, I will answer Mr. Kemper, so far as his remarks allude to me, a little late on.

COL. S. F. LEWIS: I am of the same opinion as Mr. Klorer, but not in the light of an insurgent. I believe it is but right and fair to Mr. Kemper, as well as the other members of the Society, that all who desire to participate in the discussion as regards the treatment of the Mississippi River or any problem connected with this river should write out their discussions and criticisms of the paper.

My connection with the treatment of the Mississippi River dates from 1877 to the present time, some 38 years, and during this period I have been very active in laying out its levee lines from the Arkansas line on the west bank to the jump, the end of the levee system, and from the City of Baton Rouge on the east bank to Baptiste Collette Gap, the end of the levee system. Besides, I have laid out levees on the Red River, the Atchafalaya and Bayou des Glaizes, and on both banks of Bayou Lafourche. After the severe overflow of 1882, the Mississippi River Commission for the first time since its organization in 1879, recognized that levees were a necessary adjunct to the improvement of the low water channel for navigation in the river, and allotted in that year \$1,000,000 of the \$5,000,000 voted by Congress for the improvement of the Mississippi River, toward the building of levees. Under Capt. H. L. Marshall, United States

Engineer in charge of the Third District at that time, now retired Brigadier General of Engineers, U. S. A., as a member of the Board of State Engineers of Louisiana, I had charge of the location of levees to be built by the United States Government in the State of Louisiana from the Arkansas line to Bedford's, which is opposite and six miles below Vicksburg, Miss., at that time the headquarters of the Mississippi River Commission, Third United States Engineering District.

The flood of 1882 had disheartened the riparian owners. The allotment of \$1,000,000 by the United States Government toward the rebuilding of levees proved an incentive and encouragement to the dwellers of the Mississippi Valley and resulted in the formulation of Levee Districts with extraordinary powers of taxation, etc., and from this time on until, to date, the Mississippi River Commission has undertaken in coöperation with the different Levee Boards throughout the Valley, the task of strengthening by enlargement the existing line of levees, the construction of new levees, and the prevention of erosion of river bank in the prominent bends, and harbors. It has been a herculean task, involving the expenditure of some \$42,000,000 by the State of Louisiana since the year 1865 up to date; \$27,000,000 by the State of Mississippi; \$6,500,000 by the State of Arkansas, and the United States Government has contributed for levees \$30,000,000, and about \$16,000,000 for bank revetment, and it will involve the expenditure of additional sums of money to complete to established and fixed grades these levees and revet the caving bends. By proper maintenance and policing of the levee lines, on some such system as is practiced in Holland and Belgium, and by the prevention of caving of river bank relegated to the United States Government, the all "levees only" policy will be found to be the correct one with the engineer of broad, enlightened and expanded view, in contradiction to the mushroom promoters and engineers who live by their wits to cajole and fool the ordinary layman.

As to "the principles of hydraulic engineering applied to the Mississippi River," that is a phrase or form of expression used very often by men of small intellect, as a bugaboo to frighten an engineer of similar caliber. The author of this

paper, I gainsay, knows that the elementary principles of hydraulic engineering are being applied daily by the engineers employed on levees, bank protection work, etc., on the Mississippi River. Probably he does not care to know, and would like to have the chip from the shoulder to be knocked off in an eddy current so that he could convince the engineers that they had placed the "cart before the horse." This reminds me of a little experience of my own with old Grandpa Spies, a German of Donaldsonville fame, during the high water of 1908. Whilst standing on the crown of the levee, at the crest of the flood, with several planters, this old gentleman, now dead, made this very sensible remark: "Vot does these river engineers know, anyhow; lookt, see dat chip sailing upstream; isn't dat enough proof that the Gulf of Mexico is filling up this river?" Well, Commodore Maury tells us in his *Physical Geography* that the Mississippi River paradoxically runs upstream, for its mouth is farther from the center of the earth than its head. He tells us further that the concave bends are caused by the centripetal force due to the daily revolutions of the earth's surface; and then we have the book of books, "Humphrey and Abbott's Report on the Mississippi River," the Bible as it were. This is the book which some engineers of to-day frequently quote and misquote. What the young engineer who desires to make a study of the Mississippi River should do, is to follow the advice of Lord Verulam, read everything that has been written or taken in testimony on this subject, whilst he is engaged practically in this specialty of the profession, but I would not recommend to him to swallow all the literature published on the subject, but rather admonish him to discriminate by chewing it carefully, so as to digest the leaven, and discard the chaff.

The question of assisting the "levees" by reducing the hydrostatic pressure during extraordinary floods, by reservoirs, spillways or outlets below Red River, has been discussed time and again. The author seems to dwell on the advantage of a spillway located about ten miles below Canal street, in the neighborhood of Lake Borgne Canal, but admits that he is unable to accurately calculate how wide the spillway should be to accomplish this result. Well, that is the whole meat in the

cocoanut; he, nor any other engineer who has given this subject any study and serious thought, has been able to accurately locate spillways, the required number, or to guarantee that the spillway or spillways will not silt up, etc. I believe the spillway idea is somewhat tantamount to the reservoir conception. My conception of a reservoir system would be to erect on the crown of the levees on both banks of the river a sufficient number of cisterns or tanks, calculated to relieve the lower river of the required number of cubic feet per second. These cisterns could be filled and replenished by pumps, which could be operated either by utilizing the current in the river on the Ecmuthesis theory of Prof. Fontaine, or by erecting at certain intervals windmills, "a la Don Quixote," thus utilizing either wind or water power to relieve the lower Mississippi River of its surplus water at flood times, and by spilling it over the Valley in homeopathic doses, the inhabitants of the Valley could use it for domestic purposes.

To create a spillway or outlet to the Mississippi River in the neighborhood of New Orleans, on the east bank of the river, be it located at Bonnet Carré, which is but five miles across land to Lake Pontchartrain, or ten miles below the city into Lake Borgne, which is about five miles across the land from the river, and nearer the Gulf, or at Kennerville, as suggested and reported by a United States engineer, or several spillways as suggested and reported by a United States engineer. In my opinion, experience and study of the Mississippi River, on the effect of past crevasses, teach us that these spillways will silt up and form land, and in the course of time will practically close themselves. As an illustration of this fact, it is well known that the Jump, a crevasse that took place some sixty or seventy years ago on the west bank of the river some eighty-five miles below the City of New Orleans, was navigable for vessels drawing eighteen feet or more, at its incipency, and was used for many years by them as a short cut to the west in their trade to Galveston, Indianola, Tampico, Vera Cruz, etc. To-day there is no such depth of channel through the Jump; it has silted up and made land to such an extent that an ordinary gasoline launch or lugger drawing four feet can scarcely get

through it. So it is with Cubitt's Gap or crevasse, on the east bank of the river and a few miles above the head of the Passes, at the upper end of which, where new land has been made by deposit through this crevasse, which took place some forty or fifty years ago, the new Quarantine Station has been built. The Bonnet Carré crevasse took place in the flood year of 1874. It was for the time being a great spillway or outlet and relieved the City of New Orleans from a threatened overflow. It ran for eight years and was closed in 1882, just previous to the flood year of 1882. In its incipiency it discharged fully one-fourth of the volume of water in the Mississippi River flowing by at that point, when it was closed, the previous deep swamp of five miles to Lake Pontchartrain was silted up, and the channels of the crevasse had gradually refilled. You can drive from the river to Lake Pontchartrain to-day through five miles of the finest land in the State, where, previous to 1874, existed an impassable swamp. With these facts staring us in the face, I cannot understand why any engineer who is giving this subject much thought and study can advocate any permanent relief of flood waters of the Mississippi River through spillways.

THE PRESIDENT: Is there anyone else who wants to discuss this question to-night? I am very glad to see some men here to-night for this discussion that I have not seen here in years: Mr. Knobloch, Mr. Barton, and Mr. Waddill, of the United States Engineers' Office. I would be glad to hear from Mr. Knobloch if he has anything to say.

MR. KNOBLOCH: I am not a member here. I don't care to discuss it.

THE PRESIDENT: You are certainly a welcome guest at this meeting.

MR. KNOBLOCH: Relative gauge heights depend on the stage of the water when the rise comes, and whether one rise is followed by successive rises; and, therefore, gauge relations will differ from one year to another, unless the same conditions exist. It is a fact, as stated by Mr. Lewis, that in 1890 the crevasses which occurred between Red River Landing and New Orleans discharged about 700,000 cubic feet of water per second, and

Bayou Lafourche discharged that year on a lowered river about 31,000 cubic feet per second.

MR. KEMPER: Were they discharging all at the same time, do you know?

MR. KNOBLOCH: Yes, sir. About May 22.

MR. KEMPER: All of it?

MR. KNOBLOCH: Yes, sir.

MR. KEMPER: I have been unable to get any figures showing Bayou Lafourche discharging that much, and that is the reason why I do not know positively. I have never heard of it before discharging that much water. But what became of that water, and where did it come from?

MR. KNOBLOCH: That's what I don't know, and that is why I doubt the accuracy of discharge measurements.

MR. KEMPER: Somebody ought to find out.

THE PRESIDENT: Mr. Barton, may I call on you?

MR. BARTON: I have nothing to say.

THE PRESIDENT: I believe some of the men are reserving their discussions so as to present them in writing.

MR. LEWIS: I want to say that from the Jump down to the mouth of the river there is a fast spillway, and has been for a good many years. Now, at the Jump, the river is about one hundred and twenty feet deep, and it gradually slopes up to less than thirty feet at the mouth of the river. I think that is an evidence that the spillways do less than the current in the main river, and cause the sediment to drop and show a deteriorating capacity of the stream.

MR. KEMPER: I will take exception with you there, Mr. Lewis; that is down at the mouth of the river that you are speaking of—

MR. LEWIS: The Jump is nearly forty miles above the mouth of the river—

MR. KEMPER: Well, I know; but we are beginning to get openings in the Gulf, and at low water stage, when there is almost no water going down the river—in meeting a tide from the Gulf, coming up there, they are highest when there is absolutely no current. I have never argued that there would be no deposit around there when there was no current, but in the

river, not in the vicinity of the mouth of the river, there is always ample current to carry all sediment—but you must not be influenced by the rising tide, which will offset the flow of the water.

MR. COLEMAN: On that line, though, I think you will admit that the Jetties are successful. If I understand the theory correctly, it is that the confinement of the stream within fixed lines causes a scouring of the channel to a correct depth because it induces a greater velocity. That theory was fought by the United States engineers just as you are fighting that same view, that same theory, right now. This was fought out at the time Mr. Eads advanced his project for the Jetties. Since the construction of the Jetties, but for the disturbance in regimen created by the Pass a l'Outre crevasse, they have maintained themselves; and there is certainly a very much greater depth of channel than they were ever able to maintain through that bar of deposit before by any other means.

It seems to me that this levee question is just another branch of the same problem which was solved by the construction of the Jetties. If the Eads Jetties were correct in scientific principles, which I believe they have shown themselves to be, then the levee theory is merely an extension of the same line of scientific thought and principle.

MR. KEMPER: I cannot see it yet. In the building of the Jetties, Mr. Eads took South Pass, he extended the Jetties on out into the Gulf, and in that manner maintained a current through that pass; but in order to do it, he certainly made the river swell a little above the head of the pass. The purpose was all right to maintain a current in South Pass; all he did was to confine that water so as to give a sufficient slope through a sufficient length to maintain a continuous current; it did not have to be four feet a second, nor even two feet a second, to carry all of the solid matter contained within that water, but it had to be a continuous current, otherwise the return of the tide would at times cause an absolute cessation, and would certainly mean a deposit at the bottom. For the purposes for which the Jetties were intended, they were the real thing, but to apply those prin-

ciples up here to the river, which has already more current than it needs to carry all the solid matter in it, is simply ridiculous.

MR. COLEMAN: I cannot agree with you.

MR. KEMPER: Well, that probable deposit at low water might be due, as I say, to that enormous increase of cross section from two hundred thousand square feet, up to probably over eight hundred thousand square feet. I have not studied that question well enough to discuss it intelligently, and as I said, just now, I would like to see some accurate discussions on it. When I was a school boy, my graduating thesis was the Eads Jetties. I read all the books by E. L. Corthell, and heard him lecture, and then I got up this erudite (?) essay on that subject. That was quite a good while ago, too.

THE PRESIDENT: Well, gentlemen, if there is no further discussion, I am sure Mr. Anderson, the editor, will welcome all further discussions in writing on this subject.

MR. KLOMER (by letter): Mr. Kemper questions the accuracy of two statements made by me on the occasion when Major Kerr's paper was read before the Society. One of the statements is relative to the discharge of Bayou Lafourche which I had referred to as having been between 35,000 and 40,000 cubic feet per second. Mr. Kemper thinks the discharge did not exceed 11,000 cubic feet per second. Humphreys and Abbott give it as being 11,500 cubic feet per second at the high water stage in 1851.

The report of the Chief of Engineers, United States Army, for 1890, page 3314, gives the discharge of Bayou Lafourche on February 21, 1890, with the gauge reading 23.64, as being 31,963 cubic feet per second. As the above measurement was taken at a stage 8.6 feet lower than the 1903 high water, and 9.1 feet lower than the 1897 high water, I am disposed to consider my statement as being not very far off from the actual discharge.

The other statement questioned by Mr. Kemper was to the effect that since the closure of Bayou Lafourche, the gauges at Donaldsonville and College Point show readings 6 to 8 tenths lower for a given gauge reading at Baton Rouge than the rela-

tive readings previous to the closure of the Bayou, or previous to 1904.

In his refutation of this statement, Mr. Kemper quotes three sets of readings; one set of which gives such contradictory results that he himself disposes of it by saying that "it is probable that the crevasse in 1884 caused this unexpected variation and the figures are valueless to prove either contention." The second and third set of readings quoted show an increased height of one-tenth at Donaldsonville, and an increased height of three-tenths at College Point, in the one case, and a decreased height of two-tenths at Donaldsonville, with an increased height of .29 at College Point in the other case.

The second set of gauge readings submitted by Mr. Kemper are those selected at a stage when the river is just getting over the crests of the batture (30 feet on Baton Rouge), and when the ratio of cross-sectional area of the river to each vertical foot of the respective gauges is more or less disturbed. Little importance need be attached to this point if the interval of comparison be short, but in the sixteen-year interval from 1894 to 1910, it is fair to assume that the battures must have undergone some changes in elevation.

As to the third set of readings quoted, I wish to say that it is quite possible to take isolated readings of some one year before the closure and some one year after the closure and get results similar to those obtained by Mr. Kemper. In the evidence submitted hereafter in support of my contention, there will appear instances of this kind, but they are not numerous enough or persistent enough to affect the conclusion reached.

With a view to presenting graphically the tendency to lower readings on the Donaldsonville and College Point gauges since the closure of Bayou Lafourche, I have prepared a diagram of gauge-relation curves constructed by using rectangular co-ordinates—the Baton Rouge gauge being the axis of "X" and the Donaldsonville gauge the axis of "Y." In plotting, the Baton Rouge 8 a. m. reading and the Donaldsonville 4 p. m. reading were used as co-ordinates of the point on the curve. This allows a time interval of eight hours between Baton Rouge and Donaldsonville, and while the actual time-interval is probably

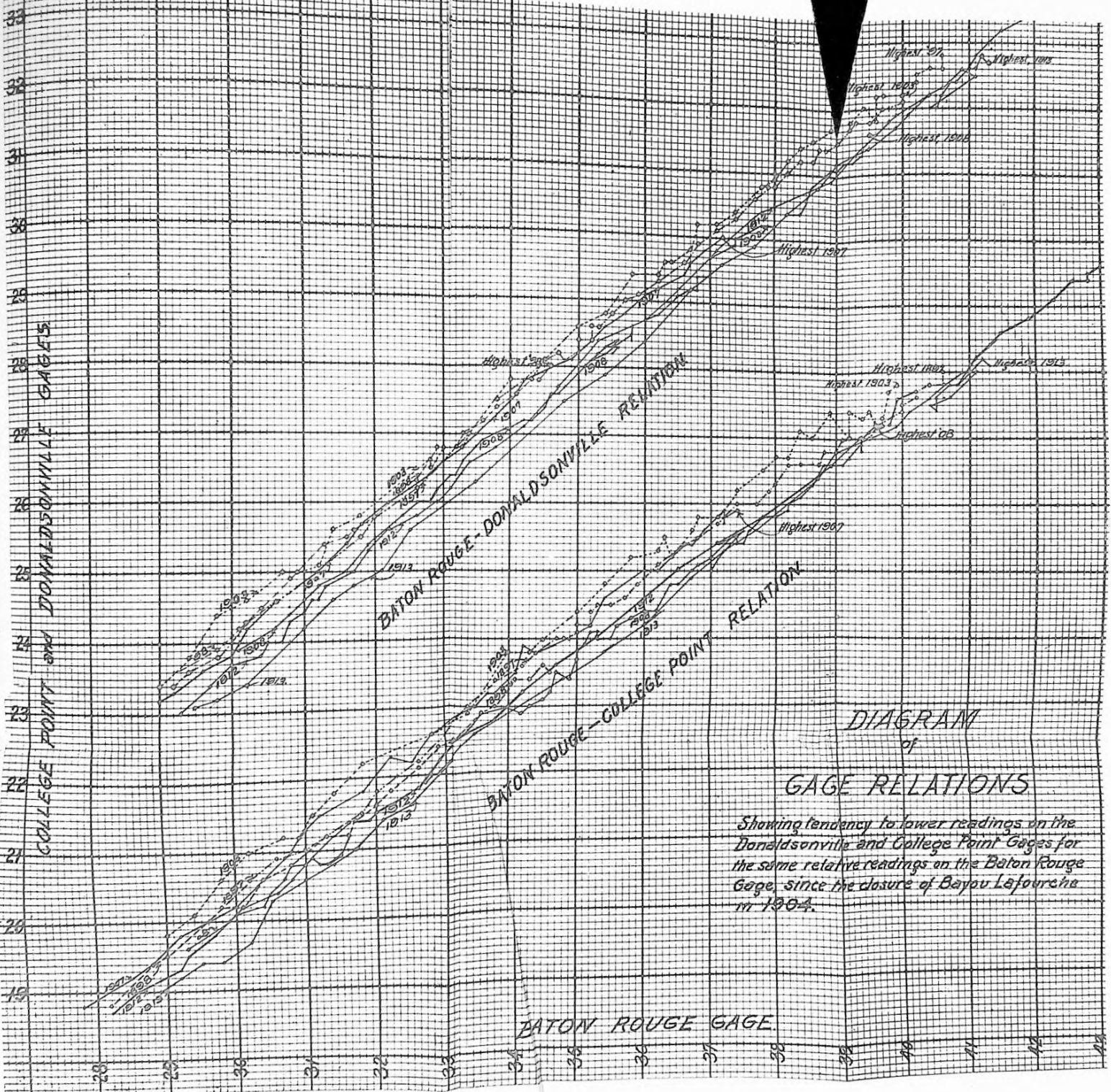


DIAGRAM of GAGE RELATIONS

Showing tendency to lower readings on the Donaldsonville and College Point Gages for the same relative readings on the Baton Rouge Gage, since the closure of Bayou Lafourche in 1904.

more nearly ten or twelve hours, the only available daily gauge readings were those of 8 a. m. and 4 p. m., and the 4 p. m. Donaldsonville reading was preferable to the 8 a. m. reading of the next day.

I should have preferred to construct these curves with the characteristic readings and discard the obviously irregular readings due to local wind effect, eddy action, personal equation of the observer, etc. The result would have been a smoother, clearer diagram, less trying to the reader's eyes and patience in following each curve through the tangled skein presented.

Gauge readings for seven high waters are plotted: 1897, 1898, 1903, before the closure, and 1907, 1908, 1912, 1913 since the closure. The ante-closure curves are shown in dotted lines, the post-closure curves in full lines. It is at once apparent that the post-closure curves, with one exception, give lower values on the Donaldsonville and College Point gauges. The exception is the 1907 curve, which was the first high water following the closure of the Bayou. One can almost trace on the curve the effect of the hydraulic dredging that this high water was engaged in after it reached a stage of twenty-eight feet on the Donaldsonville gauge.

The amount of lowering on the Donaldsonville and College Point gauges can be read off the vertical scale for each foot of the Baton Rouge gauge, from which an average value can be arrived at. In my original statement, I placed this reduction at from .6 to .8, reaching that conclusion from a few comparative readings, as I did not have the plotted results at the time. The diagram submitted sustains the general statement made.

In Mr. Kemper's concluding paragraph he states:

"It all hangs upon whether or not the capacity of a river is diminished by deposit below a spillway or outlet. I have heard it asserted a thousand times that it is, but all the definite information that I have been able to get on the subject goes to show that it not only is not so but * * * it is absolutely impossible for a spillway to cause any impairment of channel."

The definite information upon which he builds his argument so positively are the experiments of Professor Forshey, re-

corded in Humphreys and Abbott's report, which, in the language of the report, "demonstrate beyond question that no practicable high water outlet can occasion any filling of the channel by deposition of sedimentary matter held in suspension by the water." "This is the crux of the question," says Mr. Kemper. "If the river can carry all the solid matter when the velocity is four (4) feet per second, why can it not carry it when the velocity is 5.6 feet per second?"

As opposed to this apparently logical conclusion or deduction, the anti-spillway advocates submit the *fact* the river *does* shoal and decrease in cross-section below crevasses and outlets. Read the following testimony before the Senate Committee on Commerce, May, 1890:

Major B. M. Harrod: "A great many crevasses were open when we first took charge of the river. We surveyed those while they were open in such cases as Bonnet Carré and Morganza, knowing they were to be closed. After closing we resurveyed and we found in both of those instances a large increase in section immediately below. For instance, we surveyed the river in the neighborhood of Morganza, this crevasse being open in 1883. Up to the time of closing that crevasse, there had been a progressive loss of section below the Morganza crevasse of some 25 per cent. That crevasse was then closed and in the ensuing year there was recovered in section about 12 per cent."

Captain Smith L. Leach, U. S. Engineer: "* * * *
We have not guessed at this thing; we have measured it, and we had no theory to establish when we made the measurement, but we made the measurement for the purpose of finding out the theory. The measurements have shown conclusively in repeated instances that when a crevasse occurs the channel for a few miles immediately below becomes distinctly smaller. When the crevasse is closed, measurements made before and after the closure have shown that this loss in the area of the channel is recovered."

Captain Dan C. Kingman, U. S. Engineer: "The Morganza crevasse occurred in 1874, and remained open as a crevasse practically until closed in the winter of 1886-87, a period of about twelve (12) years. It has a deep bend there and plenty of water, and there had been no trouble with the navigation until after the crevasse was formed. Then navigation grew worse and worse; the channel became so narrow that it was difficult for two steamboats to pass. Since the closure of the crevasse, conditions steadily improved, and the normal conditions before the break were restored. Similar changes in channel capacity were noted at Bonnet Carré."

Captain, C. F. Powell, U. S. Engineer, in the report of the Mississippi River Commission for 1891, page 3,468, says, relative to Bonnet Carré crevasse, which remained open from 1874 to 1882:

"The increase of mean sectional area from 1882 to 1884—about 13 per cent—apparently indicates a scouring from a closed crevasse over that of an open one, which inference is confirmed by the measurement of the intermediate year."

Other statements to the same effect may be quoted; they, however, would be simply other ways of saying the same thing.

But, declares Mr. Kemper, "Their contention is wrong, or the laws are wrong." Neither are wrong. It is Mr. Kemper who is wrong. He is wrong in assuming that if any material be deposited in the channel it must be obtained from the material carried in suspension. The difficulty of reconciling the fact of deposits taking place in spite of the presence of velocities apparently sufficient to carry much more than the load in suspension, worried even Professor Forshey. For, in his pamphlet on the "Physics of the Gulf of Mexico, and Its Chief Affluent, the Mississippi River," published in 1877, seventeen years after the publication of the Humphreys and Abbott report, he makes the following statement:

"It was ascertained early, say within the first month of observation, that there was some other undiscovered

method of explaining the amount thrown out on the sand bars, in the crevasses of the levees and banks and carried to the bars of the river at its mouth.

"A single experiment made by the writer of these pages brought to light the secret.

"*The matter was borne along the bottom of the river, too heavy to be held in suspension. By far the greater amount passed off thus invisible. The amount could not be measured. The experiments were continued. Samples were taken during the whole of two years and the drift matter never was found absent beneath a running current. From the greatest depth on the line of observation, and from the gently sloping shore of the bar on the other side, the parcels were taken.*

"After much reflection and desire to make the estimate reliable, I have concluded to estimate the amount of drift matter rolled or pushed along the bottom of the river at three-fourths of the whole quantity by weight.

"* * * * Its composition was found to be, first, coarse silicious sand; second, mud in balls and lumps, embracing sticks and leaves, from the size of half an inch in diameter to two inches and even three inches in dimension; third, water-logged sticks, pieces of wood and roots. These constitute the drift matter of the Mississippi River."

Professor Forshey's account of the dragged load on the bottom of the river is surpassed in interest and detail by the experience of the Chief Engineer of the Illinois and St. Louis bridge, which is recorded by Robert E. McMath, a civil engineer, at one time in the employ of the United States and author of a paper on "The Mississippi River as a Silt Bearer." McMath relates how this engineer descended in a diving bell to a depth of 65 feet during a flood stage, and found the bed of the river for at least three feet in depth a moving mass, and so unstable that in endeavoring to find a footing beneath the bell, his feet penetrated through it until he could feel, although standing erect, the sand rushing past his hands, driven by a current apparently as rapid as that at the surface. "I could

discover the sand in motion at least two (2) feet below the surface of the bottom, and moving with a velocity diminishing in preportion to the depth at which I thrust my hands into it."

McMath concluded that methods of velocity-measurement and for the determination of drifted matter on the bottom are yet to be invented.

Mr. Arthur Hider, United States Assistant Engineer, spent a year making observations in the vicinity of Lake Providence, "to determine, if possible, whether any such rapid and continuous changes were in progress on the bottom as would naturally occur were large amounts of material in motion." He established the fact that material moved along the bottom of the river in the shape of sand dunes, the action accelerating with increased velocities. He calculated, by frequent soundings, the amount of material moving in dunes to be 14,000 cubic yards per twenty-four hours, and estimated that this was only about 10 per cent of the total amount of material so transported every twenty-four hours.

Mr. Hider states in his report: "As no method has been devised to measure accurately material thus in motion on the bottom, the above can only be taken as giving a crude idea of the large amount of material that is carried forward in this manner."

It would appear, then, from the evidence above cited, that the shoaling of the channel that takes place below crevasses and outlets is not necessarily caused exclusively by the deposition of the load carried in suspension, but rather by the arresting of the load that is moving along the bottom. Mr. Grove K. Gilbert in his very complete and learned treatise, "The Transportation of Debris by Running Water," calls this load the "traction load," and in that term includes all material transported by saltation, rolling, and sliding, as distinguished from material transported by suspension

Gilbert states—and it is evident—"Capacity for traction is clearly an increasing function of the stream's velocity, and the velocity is clearly an increasing function of the slope." Whether we accept the familiarly known law that the transportation capacity varies as the sixth power of the velocity (which

some investigators are disposed to consider as applying to the *size* only of the pebble that the current can move, and not to the *quantity* of material moved) or whether we accept the more conservative experimental results quoted by Gilbert to the effect that the amount transported by traction actually varied as the fifth power of the velocity and not as the sixth power, the important thing is that the capacity of the stream for moving the traction load varies as some high power of the velocity.

With a spillway in operation, of such dimensions as will lower, at its location, the flood plane five (5) feet, there will be an accelerated velocity in that part of the river above the spillway and a retarded velocity below the spillway. Values might be submitted for these relative velocities derived from hydraulic formulæ, but they would be no more correct than would be estimated values, for the reason that the inter-relation of slope and velocity and discharge on the Mississippi River is not the simple relation that exists in pipes, or flumes, or canals.

We can, for purposes of discussion, assume that the velocity above the spillway is 7.5 feet per second and the velocity below the spillway 5.5 feet per second.

The fifth power of these respective velocities are in the ratio of 4.8 to 1. So that if the actual amount of material being moved along the bottom by the current above the spillway be only 25 per cent of its traction capacity, it would exceed the traction capacity of the current below the spillway. One can conceive of a stream flowing in a rocky bed and transporting so low a proportion of its traction capacity as 25 per cent, but not of a stream like the Mississippi River, flowing in a bed that consists of material carried in suspension by the stream itself years ago.

The condition of the main channel of the Mississippi River at Red River Landing where the only remaining outlet is in operation is an indication of what we might expect to result from a spillway. The statement of members of this Society, that a sixty-foot channel has shoaled up to a nine-foot channel, is impressive, to say the least. This outlet is not tapped at the highest stage, as is the case when crevasses occur, but begins to operate at low stages, gradually increasing in discharge as the river

rises. It behaves in the orderly manner that we are told spillways will act. Nevertheless, we find the same result following, viz.: the deterioration of the channel below it.

Mr. Kemper replies to this point by stating that almost a million and a half feet per second flowed down the Mississippi River during the flood of 1912, "far more than ever before." He is in error there; the flood of 1882 gave a maximum discharge at Red River Landing of 1,595,000 cubic feet per second, and the significant fact in this connection is that the above discharge was passed with a gauge reading of 48.3, or 4.9 feet lower than the 1912 record.

MAJOR F. M. KERR (by letter):

Recurring to the paper "Advocating a Spillway Into Lake Borgne, below New Orleans, and an Increased Outlet Through the Atchafalaya, as a means of Flood Relief in Louisiana," presented by Mr. J. P. Kemper, Civil Engineer, before the Louisiana Engineering Society, at its regular meeting on June 14, 1915, the following is respectfully submitted:

Mr. Kemper seems to be painfully obsessed with the idea that anybody and everybody who ever has accepted, or ever will accept service with the advocates of the "all levee" principle, at one and the same time accepts that, in so doing, he, *ipso facto*, *presto change*, as it were, immediately, if not sooner, or words to that effect, plunges directly into abject bondage, and forever and a day scatters to the winds his higher sense of intelligence, integrity and manhood—if he ever at all possessed any claims to any *one* of the three qualities.

This appears to the writer rather a bold, if not unfortunate assumption and charge on the part of Mr. Kemper, if *numbers* speak, for if Mr. Kemper will look around somewhat more carefully than he seems to have done, he will find himself the bright particular star and shining light of, and flocking with, a rather small and professionally unrecognized class compared with that which he attempts to belittle.

Just so, Mr. Kemper's treatment of the subjects under consideration is based upon equally unguarded and untenable

assumptions unsupported in the light of fact, experience and observation, and upon references to statements and expressions of opinion readily controverted by other statements and other expressions of opinion of equal, if not stronger, force.

But, to get down to the subjects themselves, as presented in the paper:

1st. "A Spillway into Lake Borgne Below New Orleans."

Mr. Kemper seems to think he *knows* at least *three* things about this prospective spillway, and admits his positive lack of knowledge in regard to a *fourth*.

The things he seems to think he knows are as follows:

First, that the proper location for the spillway is at a point ten miles below Canal Street, *into* Lake Borgne; second, that the flood level at and in the vicinity of the spillway, and below the latter, can be fixed at a stage equal to sixteen (16) feet on the gage at Carrollton, and if he be read aright, proportionately lower than former flood levels, as far up as the Mouth of Red River; and, third, that no ill effects in the form of reduction of cross-section of the river, at and below the spillway, nor in eventually materially shoaling up the spillway itself, will result from the presence and operation of the spillway.

The thing about which he expresses his positive lack of knowledge is the *simple* little factor of *how wide* the spillway should be to permit the escape from the river of the desired number of cubic feet of water per second necessary to accomplish the purpose of the spillway; that is, lower extreme flood levels in the river some five feet.

Judging from the well-known and recorded immaterial effect upon flood planes, at and near New Orleans, of such comparatively recent crevasses, outlets, or spillways, reasonably close to New Orleans, as Nita, Hymelia, and Ames, of no inconsiderable widths and depths, the writer feels very sure that Mr. Kemper *cannot* well calculate *how wide* the Lake Borgne Spillway should be to permanently lower flood levels five feet, and seriously doubts whether anyone else can—within practicable and reasonable limits.

Mr. Kemper then proceeds to assert that a velocity of four feet per second is far more than is needed to carry to the sea

all the solid matter held in suspension by the water in the river, and accepts this rate as in force in the river at the stage at which the water would begin to flow through the spillway—ten feet on the gage at Carrollton—increasing to 5.6 feet per second up to sixteen (16) feet on said gage, or say five feet below high water, and, therefore, deduces that no depositions can or will follow in the river at the site of the spillway or below.

Mr. Kemper fails to establish his authority for the statement that a velocity of four feet per second is more than is necessary in the premises, and that, therefore, no deposition will follow from the lowering of the flood level and the reduction in discharge, resulting from a spillway; but, for the sake of argument, let us tentatively assume that it *may* be so.

Then, let us try to reconcile this with the universally accepted hydrodynamic law that in all sedimentary rivers, as the quantity of water is increased, the slopes of the bed and surface are reduced, and the river's current accelerated, the reverse being, of course, also true, as the quantity is diminished the current is retarded, and the bed and surface elevated.

Yet, in the face of this law, Mr. Kemper would reduce the quantity of water in a most conspicuously noted sediment-bearing stream with a velocity of eight feet per second, now passing the proposed site of the spillway, during high water, by the capacity of the latter—"358,000 cubic feet per second"—and yet produce no retardation in the current in the river sufficient to cause deposition.

However, outside of such a *reductio ad absurdum*, the fact remains that *any* check in velocity—let that velocity be what it may—however small, *does* produce deposition. This is not mere theory—all the experience of every observer of the river, of the past and of the present day, confirms this, while the fact is undeniably conformable to reason and common sense.

Mr. Kemper questions the accuracy of the statement, made by the writer and others, that crevasses, outlets, etc., retard the flow of the current in the main stream, and that this retardation causes the silting up of the channel, and ultimate net loss in flow in the river, and to corroborate his position, makes the following statement:

"Elaborate experiments by Mr. Forshey, covering two years, 1851 and 1852, as recorded on pages 132 and 135 of Humphreys & Abbott's Report on the Mississippi River, showed the water of the Mississippi River was, at no time, charged to near its capacity of solid matter, and the report goes on to say: 'These observations demonstrate beyond a question that no practicable high water outlet or waste-weir can occasion any filling of the channel by deposition of sedimentary matter, held in suspension by the water.'"

Taking Mr. Kemper literally, no record of any such experiments, and no such deduction is to be found on pages 132 and 135 of the report to which reference is made; but on page 392 of that report, the sentence last quoted *does* occupy space in a general exposition of the subject of sedimentation as a whole.

However, let us look a little further along and see whether it was *so safe* for Mr. Kemper to rely so entirely upon Mr. Forshey, and this quotation in support of the contention that "no practicable high water outlet or waste-weir can occasion any filling of the channel by deposition of sedimentary matter, held in suspension by the water," for listen to what Mr. Forshey is quoted, by equally good authority, as saying about the very selfsame Bonnet Carré Crevasse of 1851, used as an illustration by Mr. Kemper.

Extract from letter of Major J. G. Bernard, Corps of Engineers, U. S. Army, to Major G. W. R. Bayley, under date of December 28, 1858:

"The investigations to which I allude were made while the great Bonnet Carré Crevasse of 1850 was in full flow. On the 30th of July (immediately after the fall of the river) its bed was examined by Professor Forshey and others, who found that *immediately below the crevasse*, it was obstructed by a shoal *which diminished* the mean depth about 12 feet, and the area of section 75,613 square feet as compared with the section above the crevasse. A more extraordinary confirmation of a result of pure reasoning by the actual results of the operation carried on by nature, on a great scale, has rarely been presented."

To the results of this examination Professor Forshey appends the following note:

"Soundings made in the high water of 1851, proved that the great sand bar thrown across the channel of the river below the crevasse by the weakness of its transporting forces, was carried away again when the river was confined by the new levee, and rose high enough to assume its greatest velocity. With those accustomed to the study of hydrodynamics the above facts furnish a fortunate illustration of the effects of outlets—*verbum sap.*"

Then let us read further as to what this and at least *one* other eminent Civil Engineer of way back yonder had to say along these particular lines—Mr. G. W. R. Bayley, a noted railroad engineer, and associate of Mr. James B. Eads in designing and constructing the jetties at South Pass, the particular reason, outside of their well-known ability, for quoting these gentlemen being the fact that they treated the subject before there was ever any suspicion of any "autocratic power, inconceivable in a democratic country" jealously defending "a system founded upon unsound engineering principles," nor any horde of hungry officeholders so fearful for their jobs as to recognize the insecurity of lending "active approval to any other system of flood control than levees."

Extracts from a letter from Major J. G. Bernard, Corps of Engineers, U. S. Army, to Mr. G. W. R. Bayley, under date of December 3, 1858:

"There is but *one* protection for Louisiana, and that is *levees*; outlets, or lateral vents of any kind may be discussed—adopted by State authorities—*perhaps attempted*. If so, they will certainly deluge the unfortunate district through which their discharge is carried, while they *utterly fail to relieve* the river, producing, on the other hand, deposits in its bed, which they will eventually raise, and with it the surface." * * * * *

"The currents of the river, rather diminishing in velocity than increasing as they descend—passing for thousands of miles through caving and friable banks—may fairly be concluded to be loaded, on their arrival in Louisiana, with the *maximum* of sediment due to their velocity (*whatever that velocity may be*). Any check in

this velocity, however small, will, therefore, produce deposition." * * * * *

"Theoretically, if one-tenth of the water discharged by the river, or any proportion of same, is thrown off by any outlet in a moment of time in lower Louisiana, reduction in surface will ensue proportioned to the quantity escaping, and this reduction will continue until the river has, by deposits in its channel below, adapted itself to the new order of things; then the surface of the river below the outlet will be higher than before. One season of high water and the subsequent subsidence of the river is sufficient to complete the change, the succeeding rise in the river always being governed by the *new* order of things.

Practically, crevasses, or outlets, from small beginnings enlarge with greater or less rapidity, and inasmuch as deposits below the outlet begin at once, these may, if the outlet increases slowly, keep pace with the enlargement of the same; therefore, an immediate reduction of surface in consequence of a crevasse, *may*, and *may not*, occur. The *ultimate increased elevation* is, however, *certain* and permanent, if the outlet is permanent."

* * * * *

"It is common with many people to speculate so lightly on throwing off one, two or three hundred thousand cubic feet per second from the river by 'outlets,' that one would think that *once let out*, there was nothing more to be thought of. Unfortunately, it is just at this point that the trouble begins. *No lateral vent exists—none can be made by man*, which will carry off these one, two or three hundred thousand cubic feet, which it is wished to dispose of, so safely as the river channel itself, aided by sufficient levees."

Extracts from papers by Mr. G. W. R. Bayley, 1860:

"Outlets, crevasses, let them occur where they may, invariably elevate the plane of high water, the succeeding year at farthest, permanently, if they are permanent, temporarily if they are closed."

"In 1858 a multitude of crevasses occurred between Memphis and Vicksburg, occasioning great deposits in the channel between these points. No crevasses occurred, or remained open, between the mouth of Red River and Donaldsonville, and the river channel here being compelled to discharge all the water that was thrown into it, accommodated it without difficulty and did not diminish its depth. Below Donaldsonville the Labranche, Belle, and other crevasses lower down still, remained open the entire season, and produced deposits in the bed of the river opposite and below them."

* * * * *

"I have been informed that the bed of the Mississippi at Vicksburg was so filled up by deposits of sand (occasioned unquestionably by crevasses or outlets above, in 1858 and 1859) that the low water mark of 1859 was about seven feet higher than the old low water mark, though there was no more depth of water than formerly. The whole bed of the river, with the low water line, had been elevated about seven feet.

"This again verifies the law that *as the quantity is diminished*, the slopes of the bed and surface are increased or elevated."

* * * * *

"Crevasses never have occurred except through a neglect of levees; therefore, we want *good levees*, and nothing else; we want public opinion in favor of *enforcing* levee laws; we want a *system* of leveeing; we want to put an end to this 'outlet theory,' which is a century behind the age, because until then no levee law will be enforced; we want to procure the general recognition of the law of nature, *that the increase in quantity of water in a sedimentary river increases the current, lowers the bed, and lowers the surface.*"

* * * * *

"Major Barnard calculates the effect of a discharge of 120,000 cubic feet per second, through the Bonnet Carré crevasse, to be an ultimate increased elevation of

surface, at Carrollton, of 2 feet 9 inches, and an elevation of bed of eighteen feet six inches. Chas. Ellet, Jr., measures the Bonnet Carré crevasse (afterwards, and without a knowledge of Majar Barnard's deductions) and finds the sectional area of the river below the crevasse to be 46,291 square feet less than above it, while the sectional area of the crevasse was 43,500 feet. He also informs us that the river was 31 feet 6 inches deeper above than below the crevasse. Professor Forshey, by measurements made *after* the Bonnet Carré crevasse was re-leveed up, found that said bar below had been swept entirely away."

The Bonnet Carré crevasse of 1851 is singled out for illustration of the subject in this paper, not because it is the most striking instance of record, or alone in its strength and force of argument, but simply because Mr. Kemper himself selected it to prove his assertions.

Every crevasse, or outlet on the Mississippi, the Red, and the Atchafalaya Rivers, and on Bayou Lafourche, when it was carrying its quota of water from the Mississippi to the sea, and the good Lord knows that, at one time, there were far too many of them on *all* these streams, produced the same effect upon the bed of the stream, shoaling it *below* the crevasse or outlet.

Finally, in this paper, with particular reference to an outlet below New Orleans, into Lake Borgne, as Mr. Kemper seems to have gotten his inspirations, and taken his cue largely from the report of Messrs. Humphreys and Abbott, especially as to the effect of crevasses, outlets, etc., upon the bed and surface of the river, it will not be amiss to record the following additional expression of opinion, quoted from this self-same report, pages 401-402:

"The area of Lake Borgne being about one-third that of Lake Pontchartrain, and the mean depth about the same, it would be filled in a proportionately shorter time, and at the end of that period, the entrance to Lake Pontchartrain would be nearly closed, as the channel from the Gulf would be merely sufficient for the discharge of its

drainage. If outlets are to be used, however, this is the locality for their trial, since the results would be less injurious here than at Lake Pontchartrain."

In the same connection, this report goes on to say:

"Enough has been said to demonstrate, with all the certainty of which the subject is capable, the disastrous consequences that must follow the resort to this means of protection."

All the foregoing and much more, along the same lines, fully justified in the light of events and experience, was expressed long before the despotism and thralldom charged by Mr. Kemper, to the "all levee" advocates.

The personal experience of the writer in regard to this same subject has been extended and varied, confirming most positively that any diversion of the current in a sediment-bearing river, be the velocity what it may, *does* and always *will* induce and cause deposition, and consequent elevation of the bed and surface of the river.

2nd. "An increased outlet through the Atchafalaya, as a means of flood relief."

Mr. Kemper seems to ignore the fact, or has lost sight of the importance of its bearing on the subject, that a rather extensive *controlled* outlet from the Mississippi River into Old River and thence into the Atchafalaya River, some 1,000 feet in width, and of considerable depth, already, at all stages of the Mississippi River, exists through Old River, operating in just as correct and ladylike a way as any outlet or spillway that could well be designed by Mr. Kemper or anyone else, which, without impairment, is widened out to eight miles in width from the time the river gets out of its banks up to high water and again returns thereto.

Then Mr. Kemper proceeds to show how even *this* outlet, without increase, had it not been for the Torras crevasse, on Old River, and others on the Atchafalaya River, would have swelled flood levels at Melville, in 1912, to 52 feet instead of 41.7 feet on the gauge, as recorded. In the opinion of the writer, Mr. Kemper's deductions in regard to this "tidal wave" at Melville is based upon purely imaginary gauge relations, and

is simply on a par with the claim of a certain railroad magnate of high degree, who, backed by mathematical (?) deduction and diagrammatical (?) illustration, placed the increase in future flood levels at New Orleans at 18 feet, or say 39.4 feet instead of 21.4 feet on the gauge, should the project for separating the Red and Atchafalaya Rivers from the Mississippi River ever materialize.

Now, how much more Mr. Kemper, in the face of his own deductions along these lines, might wish to increase the present spillway through Old River ("Spoilway," most persons in that section of the State think it during high water), or how he proposes going about it, it is difficult to conceive, especially when the following well-known and admitted results positively ensue from the present modest (?) affair.

1st. It is an *outlet* only at times, not *all* times. Oftentimes, especially during periods of high water in Red River, augmented by crevasse water from breaches occurring in the lines of levee in that part of Arkansas affecting Louisiana, and in the Fifth Louisiana Levee District (State line to mouth of Red River), it becomes a material tributary to the Mississippi River, thereby notably increasing flood levels at the mouth of Red River and below.

2nd. As an outlet, it, in times of high water, in conjunction with the waters of the Ouachita, Black and Red Rivers, already, without increasing its capacity, so congests the Atchafalaya River, the lower Ouachita, the Black, and the lower Red River, as to convert that section into an inland sea some 1,300 square miles, or about 840,000 acres of territory in area, not yet protected by levees.

3rd. It has the same effect as a crevasse, or any other kind of outlet—reduction of section in the Mississippi River from deposition, and the elevation of the bed and surface of the river, opposite and below.

As for any relief to the lower Atchafalaya River itself, from an outlet from Grand Lake, at Charenton, into Cote Blanche Bay, with a width of 1000 feet and a depth of 20 feet, Mr. Kemper overlooks the fact that this outlet would deliver into the Gulf of Mexico along a shore line where a maxi-

mum depth of only about eight feet is to be found, while Grand Lake now finds its way directly to the Gulf by way of the Atchafalaya River itself, some 1500 feet wide and 60 feet deep, delivering into the Gulf through a channel-way equally as wide, if not wider, than Mr. Kemper's canal, and 26 feet and over deep.

Such an outlet would simply never be felt in the form of local relief, but tend solely to, if anything, further shoal Grand Lake, by diversion of flow, and, without the aid of more levees, overflow the territory through which it would pass, and for miles above and below the same.

In conclusion, spillways, controlled outlets, etc., simply mean more levees, longer lines of defense to protect, involve niceties of design and construction, not otherwise ever considered, costing vast sums of money, not only not justified by the relief sought, but sooner or later aggravating the very conditions about which complaint is made—increased flood levels.

Why not stand by one line of action which is *known will* take care of the surplus waters of the river passing our doors, and simply add the money proposed for spillways to their improvement, thus enabling us to that much sooner reach the goal?

"United we stand, divided we fall," is true of many more things than patriotism and our country.

With Major Barnard and Mr. Bayley, not to mention anyone of later day, for fear of subjecting myself to further charges of corrupting influences, the writer once more, as so many times in the past, conscientiously stands for "levees only," believing that for all parties and all interests concerned there is but one place for the surplus waters of the Valley—within the banks of the river, where naturally high enough to contain them, and between levees, properly located and properly constructed to ample grades and sections, where not so fortunate.

J. A. OCKERSON (by letter) :

August 9, 1915.

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

Dear Sir :

In the introduction to Mr. Kemper's paper on "Outlets as a Means of Flood Relief in Louisiana," you invite members of your Society to present written discussion of the subject. May I offer a few statements of fact in the interest of truth, which Mr. Kemper says "must prevail?"

He states that the Mississippi River Commission is an "autocratic power inconceivable in a democratic country;" that no one not previously committed to the policy of levees only "could have secured a place on the Commission." Let us see if these statements are correct.

The members of the Mississippi River Commission are appointed by the President of the United States, with the advice and consent of the Senate. The Commission is composed of seven members—three from the U. S. Engineer Corps of the Army, and four from civil life. Since its creation in 1879, thirty-two different men have been members thereof, among them many eminent men of high standing in the engineering profession. One of them, Benjamin Harrison, became President of the United States.

There have been sixty-two different executive officers in charge of works under the orders of the Commission. These officers, ranking from Captain to Lieutenant Colonel, were detailed by the Secretary of War from the Engineer Corps of the Army.

There has been, throughout the progress of the work, an able corps of civilian assistants, in immediate charge of the work—"the men behind the guns"—whose positions depended solely on their ability, energy, and devotion to duty. To them properly belongs a very large measure of the credit for the successful results that have been achieved.

The many changes that have occurred in the personnel should serve to effectually eliminate any tendencies toward dry rot, or disposition to follow a rut.

In view of the methods of appointment, detail and employment cited, Mr. Kemper's charge hardly seems reasonable, to say the least. The responsibility must necessarily rest with the several Presidents who have made the appointments, and the Secretaries of War who have made the details, officials of different political parties during the intervening years.

In the interests of truth, then, it may be stated in most positive terms, that no man in any way connected with the work has ever been required to subscribe to the doctrine of "levees only," as a condition of his appointment, detail, or employment.

Having been in personal touch with the work of the Commission for a number of years, the writer is impressed with the unanimity of opinion of the able men who have dealt with the problem of flood control, the universal conclusion being that protection from floods of the Mississippi River below Cairo without the use of levees is wholly impracticable.

This, however, is far from either approving outlets in the Louisiana delta, or condemning the use of reservoirs where that can be done with beneficial results commensurate with their cost.

Permit me to say further that the Commission, from the beginning, has been engaged in collecting and studying data covering all phases of the river's regimen, with the result that there is no river in the world whose every physical feature is better understood than that of the Mississippi River.

The great problems of the improvement of navigation and flood control were approached with open minds, and facts were sought from every available source. So it is to be hoped that Mr. Kemper will give the Commission and its staff credit for striving to reach the truth, to say the least.

The Mississippi River Commission is guided and controlled by the laws of Congress, and it has no extra-judicial powers of its own creation and therefore can have no "autocratic power."

To enter the technical side of the discussion is very tempting, but fear of trespassing on the rights of your members as well as lack of time, suggests that my remarks be limited to

what has already been written, and should this be deemed worthy of a place in the columns of your journal, it will be gratifying to me.

Very truly yours,

J. A. OCKERSON.

MR. F. H. WADDILL (by letter) :

"I rise to remark,
And my language is plain,
That for ways that are dark
And for tricks that are vain,
The 'Old Mississipp' is peculiar."

Perhaps the paraphrase should be, the "old outletist."

Mr. Kemper's paper is exceedingly interesting, but it is to be regretted that he marred its effect by what most of believe is an unwarranted attack upon our levee engineers.

As for myself, that belief is founded upon twenty-five years of acquaintance sufficiently close to justify me in setting them down as a stubborn lot, as little given to bending "the pregnant hinges of the knee where thrift may follow fawning," as any set of men could be. Moreover, vituperation is not scientific argument.

He must set his case upon a solid foundation of everlasting scientific truth, and not upon personalities, if he hopes ever to gain converts to his cause.

His spillway will, in my opinion, be of benefit for only a short distance above and for the whole distance below it, but that benefit will be only temporary, for *an alluvial stream abhors an outlet*, and, from the instant that that outlet is created industriously sets to work to close it. All the outlets which this river ever had, and they have been legion, have been closed and always through the effect of that eternal law, that silt-bearing capacity of water is in proportion to the sixth power of its velocity. I do not vouch for the sixth power of it, but that is immaterial, for if that capacity were in direct proportion only to its velocity, outlets would be closed just the same, but it would take longer.

Let us analyze what would happen were the spillway which he proposes, constructed. Assume that the gauge at Red River Landing was 53.2 and 16 at Carrollton, with ten feet of water flowing through the spillway.

Since the area of cross-section at Carrollton has been reduced from 21 to 16, or 5 feet times the width, the velocity must be greatly increased in order that the same volume may pass as would at 21, that is to say, the slope at the surface must greatly increase. Mr. Kemper says: "If I understand this problem right, owing to the diminished cross-section at Carrollton, the increase of velocity will be a gradual acceleration from Red River Landing," etc.

That is precisely the trouble, *he does not understand the problem aright*, and that is also precisely the trouble with all the outletists.

The fact is, that there would be no gradual increase from Red River down, as anybody knows who has ever watched water flowing in a ditch which emptied in a stream in a waterfall.

What would happen is that the profile of the water surface from Red River to Carrollton, which we may assume as a straight line at present with gauges at 53.2 and 21 respectively, would, with the spillway in operation, assume the curve, probably of a parabola with the vertex down stream. That is to say, that there would be no appreciable lowering of the flood height anywhere along the line, except for a short distance above Carrollton.

This is so theoretically and it claimed that crevasses prove it.

The slope above Carrollton would decrease going upstream in an ever increasing ratio, until it tapered off into the original slope which obtains with gauges at 53.2 and 21.

If the outletists do not believe this, let them assume a uniform cross-section from Red River to Carrollton and, by the "cut and try" method and Chezy's formula, calculate the areas and consequently the elevations of water surface, at each mile from Red River to Carrollton, and they will be convinced.

To be frank, though, I must admit that I haven't done it.

I have arrived at this conclusion by the analytical method rather than the experimental. It is so much easier.

Since the area of effective cross-section in the river just above and below the spillway will be the same, the velocity below must necessarily be less than that above, otherwise the discharge would be the same and the discharge from the spillway would come from nowhere. That is so exorciatingly self-evident that even an outletist must admit it.

Now, whatever Humphrey and Abbott may say about it, my intellectual processes are such that I could just as readily believe in the divine right of kings or that the earth was flat or that the moon was made of green cheese, as I could believe that deposit would not take place below the spillway.

That the water ever carries less silt than its velocity justifies, is to me unbelievable.

The molecules of water do not flow in relatively horizontal, parallel lines, but follow more or less cycloidal paths. There is a mighty rolling and churning motion and I suspect that all the molecules move in *some direction* at a practically *uniform velocity*. And it is this kind of motion which projects the molecules violently against the bottom and enables them to overcome cohesion and tear particles of material loose from the bottom and carry them along.

That they ever "loaf on the job," I cannot believe.

It is only the human, with his master intellect, who can figure out where that pays.

And so I say that there will be deposit below the spillway. But that is not all. The increased slope above the spillway will impart added energy to those honest little molecules, and those five feet of lost depth, and perhaps more, will in time scour out. The profile of the flood height will approach more nearly to the assumed straight line slope from Red River to Carrollton, in fact eventually coincide with it, thus lowering the floor height at Baton Rouge and Donaldsonville, as Mr. Kemper says it will. So it would. So it would, but for the fact that the silt so scoured would be dumped on the bottom, below the spillway, and in the spillway channel, until this, together with the original residual silt, would destroy the effectiveness of the arrangement until the flood height rose right back to 21 on the Carrollton gauge.

Again I say, so it would except for one thing. Your spillway would fill up Lake Borgne, except for a channel say in the middle. That process would begin at the mouth of the spillway.

A mud bar would form with a channel through it. But why detail a process with which we are all familiar? The spillway would be lengthened. The ratio of slope decreased. Follow this with your mind's eye, and what becomes of the spillway? The river itself has shown us. With a giant brush she has painted upon the map, at the very point selected by Mr. Kemper, her everlasting condemnation of his project.

Look at Bayou Terre-aux-Boeuf and the Louisiana marshes, spreading out in a monstrous fan, and remember that that bayou was once a delta mouth as wide as any of the Passes.

Having effaced the spillway, the river would then scour itself below the spillway to the original depth and the cross-section then would be too large from Red River to Carrollton (the velocity having decreased), would fill up to its present grade and the situation will be as if the spillway never had been.

Regarding the Atchafalaya I shall say little, as I have already perhaps trespassed too much upon your time and patience.

That stream might be called an accident. It was, if you will, a crevasse, caused by the progressing westward of the Old River Loop until it broke into Red River, the upper part of the Atchafalaya being nothing but the original bed of Red River. (See La Tourette's map of the State of Louisiana, dated 1845.)

If let alone it will go the way of all outlets or else the Mississippi River will abandon its present channel and take that instead. I think the conditions justify the belief that it will, after depopulating the area from the Mississippi Ridge to the Attakapas, but at the same time filling up those immense intervening swamps and marshes and rendering them habitable by man, dwindle to a second Bayou Terre-aux-Boeuf or Bayou Lafourche.

If let alone it will increase enormously at its upper end.

It will take ever and ever more water from the Mississippi.

As I have shown, it will fill the channel of the Mississippi below without materially lowering the flood height at

Red River Landing. The construction of the channel below will keep step with the increase of the Atchafalaya. The time will come when we must stand helplessly by and let it wreak its ruin and devastation.

It should be closed now, while it can be. If delayed too long the job will be too great, even for a Goethals, for it must be done between two high waters, for obvious reasons.

If it is not to be done, then Mr. Kemper's idea, about spacing the parallel lines of levees at the lower end, is correct, although his formula for doing so is wrong. It is very true that the discharge is proportional to the square root of the slope, but that applies to one, sole, and only cross-section where all the other factors in the equation, except the slope, are constant.

In conclusion I will state that I am an amateur in this business of the Mississippi River. I have never had the time nor the occasion for acquiring the facts necessary to a complete and thorough knowledge of the subject, and I give my views for what they are worth.

But it does seem to me that those whose business it is, from the Mississippi River Commission down, have dawdled with it until the people have come to believe that they know quite as much about it as the experts and are inclined to take matters into their own hands.

When untutored and unled, they always surge hither and yon, grasping at this straw and that, following any leader that proclaims himself as such, trying this thing and that, until by some fortuitous accident they stumble upon the right.

Should not those who know assume this leadership, not passively, but with that virile, driving energy that always convinces and wins?

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Board of Direction, July 30, 1915.

The meeting was called to order with President Datz in the chair. Messrs. Coleman, Olsen, Young and Hogg were present.

Minutes of the last meeting were read and approved.

A number of applications for membership were read and passed to ballot subject to the approval of the Membership Committee. The names of the applicants are as follows: C. Glenn Cappel, 104 New Orleans Court Bldg., New Orleans; Frank Amende Muth, 2323 Short street, New Orleans; Farrar Petrie Hamilton, 601 Interstate Bank Bldg., New Orleans; Jackson W. Waters, 2611 Canal street, New Orleans; John Adolphe Commagere, Jr., 1453 N. Robertson street, New Orleans; Charles Henry Shapleigh, 1002 Q. & C. Bldg., New Orleans; H. M. Hariman, 7920 Spruce street, New Orleans; Frederic Nichols Billingsley, Interstate Bank Bldg., New Orleans.

Nonresident Member—Edward W. Bres, U. S. Eng. Office, Q. & C. Bldg., New Orleans.

Junior Member—Lucien John Troxler, Jr., 516 Jena street, New Orleans.

The question of auditing the books was referred to the President with full power to act.

The following bills were approved for payment:

F. D. Daubert, refreshments, June meeting.....	\$ 10.50
Tulane University Press, printing and stationery.....	33.85
Miss E. Francke, stenographic services (W. H. Williams).....	5.00
Miss Alice Cooper, stenographic services (L. C. Datz).....	10.00
Eugene Dietzgen Co., books for library.....	26.90
O. L. Durell, stenographic services, June meeting.....	12.50
Douglas Anderson, salary half year 1915, January to June, as Editor of Proceedings.....	150.00
W. T. Hogg, salary and incidentals as Secretary.....	26.61

The following bills were approved subject to the approval of Prof. Anderson:

Tulane University Press, Proceedings for June.....	\$150.26
Extra copies Proceedings for June.....	35.00
Advance copies J. P. Kemper's paper.....	8.10

There being no further business, the meeting adjourned.

W. T. HOGG,
Secretary.

Regular Meeting of the Board of Direction, September 13, 1915.

The meeting was called to order with President Datz in the chair. Messrs. Coleman, Datz, Dusenbury, Gregory, Williams, Young and Hogg were present.

Minutes of the last meeting were read and approved.

Ballots for the election of new members were opened. There were 52 formal and 4 informal ballots. The following were unanimously elected:

Resident embers—C. Glenn Cappel, 104 New Orleans Court Bldg., New Orleans; John Adolphe Commagere, Jr., 1453 N. Robertson street, New Orleans; Frederick Nichols Billingsley, Interstate Bank Bldg., New Orleans; Farrar Petrie Hamilton, 601 Interstate Bank Bldg., New Orleans; H. M. Harriman, 7920 Spruce street, New Orleans; Frank Amende Muth, 2323 Short street, New Orleans; Charles Henry Shapleigh, 1002 Q. & C. Bldg., New Orleans; Jackson W. Waters, 2611 Canal street, New Orleans.

Nonresident Member—Edward W. Bres, U. S. Eng. Office, Q. & C. Bldg., New Orleans.

Junior Member—Lucien John Troxler, Jr., 516 Jena street, New Orleans.

A number of applications for membership were ordered to ballot, subject to the approval of the Membership Committee. The applicants are as follows:

Resident Members—Lester F. Alexander, 834 Audubon street, New Orleans; Schuyler P. Coleman, 1446 Nashville avenue, New Orleans; J. L. Dickey, New Orleans; James M. Geary, 707 Title Guarantee Bldg., New Orleans; Edgar Louis Stream, care Vaccaro Bros. & Co., New Orleans.

Nonresident Member—Fred I. Getty, Jennings, La.; A. Rogers Mielly, 908 Southern Pacific Bldg., Houston, Tex.

Junior Member—A. M. Fromherz, 1133 Fourth street, New Orleans.

A communication from Mr. W. H. Williams was read. It was moved, seconded, and carried, that the communication be referred to the Publication Committee with full power to act.

The following bills were approved for payment:

W. T. Hogg, salary two months and incidentals.....	\$ 44.83
Tulane University Press, printing and stationery.....	3.50
Doullut & Williams, mailing journals, etc.....	8.59

The following bills were approved subject to approval of Prof. Anderson:

Tulane University Press, Proceedings for August.....	\$128.35
John Klorer, engraving for paper.....	10.00

The following bills were approved subject to approval of Library Committee:

Miss Carrie S. Freret, services in Library.....	\$ 15.00
Am. Soc. Munc. Improvements, 1914 Proceedings.....	2.00
Industrial Engineering, subscription.....	2.00

There being no further business, the meeting adjourned.

W. T. HOGG,
Secretary.

Regular Meeting of the Society, September 13, 1915.

The meeting was called to order with President Datz in the chair and 34 members and guests present.

Minutes of the last meeting were read and approved.

An invitation from the Secretary of State was read. The Society is invited to participate by one or more delegates in the Second Pan-American Scientific Congress to be held in Washington, D. C., from December 27, 1915, to January 8, 1916. It was moved, seconded, and carried, that the invitation be acknowledged and accepted.

A communication from Mr. F. H. Newell, chairman of the Committee on Engineering Coöperation, was read. Mr. Newell called the attention of the Society to the importance of the coöperative movement, and urged the Society to devote one meeting a year to the consideration of the engineer and his relations to the public.

Prof. Gregory stated that the American Society of Mechanical Engineers would hold their spring meeting in New Orleans. He stated that the policy of the Society had been changed in that each member pays his own expenses in attending meetings outside of New York.

The technical exercises of the evening were then held. Mr. A. W. Jackson read a very interesting paper entitled "Military Engineering." The paper was followed by considerable discussion.

There being no further business, the meeting adjourned to the collation.

W. T. HOGG,
Secretary.

RECENT ADDITIONS TO THE LIBRARY.

Proceedings of American Society of Municipal Improvements.

Haven & Swett's "The Design of Steam Boilers and Pressure Vessels."

J. L. Van Ornum's "The Regulation of Rivers."

George F. Swain's "The Conservation of Water by Storage."

E. A. Moritz's "Working Data for Irrigation Engineers."

PROCEEDINGS

—OF THE—

LOUISIANA ENGINEERING SOCIETY

VOL. I

DECEMBER, 1915

No. 6

CONTENTS

EDITORIAL NOTES AND COMMENT:

	PAGE
Military Engineering	283
Reinforced Concrete for Highway Bridges.....	284
The International Engineering Congress	285
The State Board of Engineering Examiners	286
New Members	288
Our Advertisers.....	288
The Dietzgen Employment Bureau	289

BOOK REVIEWS	290
--------------------	-----

PAPERS AND DISCUSSIONS:

Military Engineering. <i>By A. W. Jackman</i> ..	292
A Suggested Form of Construction for Highway Bridges in Louisiana, The Reinforced Concrete Arch. <i>By</i> <i>Donald Derickson</i>	300
Discussion Upon "Military Engineering" ..	315
Discussion Upon "A Spillway Into Lake Borgne (con- tinued)	327

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY	360
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DIRECTORY OF OFFICERS.

L. C. DATZ, President, 201 Baronne Street.
SAMUEL YOUNG, Vice-President, 1002 Perrin Building.
E. H. COLEMAN, Treasurer, 920 Hibernia Building.
W. T. HOGG, Secretary, Tulane University, P. O. Station 20.

DIRECTORS.

W. H. WILLIAMS, 1016 Hibernia Building.
W. B. GREGORY, Tulane University of Louisiana.
A. T. DUSENBURY, 901 Maison Blanche Building.
OLE K. OLSEN, 823 Perdido Street.

The headquarters of the Society are in the State Museum
Building, Jackson Square.

Address all business communications to W. T. Hogg, Secretary,
P. O. Station 20, New Orleans, La.

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DOUGLAS ANDERSON, Editor.

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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. I

DECEMBER, 1915

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EDITORIAL NOTES AND COMMENT

Military Engineering.—It might almost be said that the real origin of the profession of engineering lay in the apparently unconquerable propensity which the human animal has always had for settling some of his many difficult problems by the simple process of getting out and fighting. Simple as the methods of warfare may have been in the early beginnings, they all eventually developed to a point where hand-to-hand combats were replaced by machines of various sorts, the general object of all of them being to throw projectiles of various kinds and in such a way as to do as much harm as possible to the enemy. As a natural result there soon followed the development of structures of different kinds to serve as defenses against the projectile machines. Another very important and necessary factor in the warfare of tribes or nations was the provision of means of getting the fighting men from place to place; this leading to the development of road building, a division of engineering in which the ancient and mediaeval engineers were no mean rivals of our best engineers of modern times. One might thus go on *ad libitum* tracing the close connection between the development of warfare and engineering down to our very own times when we see evidences on every hand of how the very best inventive genius and engineering skill is being utilized in the gigantic struggle among the nations of Europe. The term Civil Engineer, itself, is suggestive of the fact that engineering as such was originally a sort of monopoly of the army man.

Mr. Jackman's paper on Military Engineering is of peculiarly timely interest now when the public mind is so busily occupied with the great problem of "preparedness" for our own country, and when we stand as interested observers of the effect of preparedness and engineering efficiency on the progress of the great war abroad. The paper calls attention to the need of more men in the engineer corps of the regular army, and also to the necessity of providing some efficient method of training volunteer engineers as officers. There is apparently no great trouble in getting numbers of engineers to volunteer in times of emergency, but very few of them are qualified by training or experience to act as officers and to handle the many problems that come up in the manner to which the military man is so thoroughly accustomed. Some interesting details are given of the many and varied duties of the army engineer officer and the somewhat rough and ready methods he must use and the limited appliances available for much of the rapid field work.

The discussion brought out by the paper dealt largely with the problems of range finding and gun sighting with coast defence guns and with guns aboard ship. Although from the nature of the two cases there are many essential differences, yet there is one point in which they appear to be in close agreement. And that is, after all the observations have been made and all the corrections have been applied to the problem of finding the range of the object under fire, the accuracy of the aim depends very greatly upon the gun pointer himself. He must be a man of good nerve, with a quick eye, and always ready to note every little detail which will help him to apply automatically, as it were, the necessary corrections to the indicated range in order to increase the accuracy of his firing.

The Use of Reinforced Concrete for Highway Bridges.—The importance of "Good Roads" to the State of Louisiana, and the work which has already been done along these lines, as well as the plans for the future, have been set forth in the pages of this journal in the very excellent paper of Mr. C. M. Kerr, published in the August issue. For this issue Prof. Donald

Derickson has prepared a paper which should prove of great value to engineers who are dealing with the problem of the selection of a proper type of bridge for use in highway work in this and neighboring states. The paper discusses the conditions to which such a form of bridge is best adapted, gives the detail drawings for the same, and adds finally an estimate of the cost, with some comparative data as to the cost of a steel bridge for the same conditions. Another valuable feature of the paper is the very complete and suggestive bibliography on the subject of the reinforced concrete arch. All of these references are to be found in either the Library of the Society or in that of Tulane University.

The publication of this paper sets the example and marks the beginning of a line of work, which the Editor hopes, with the coöperation of the members of the Society, to develop into a feature of our journal which will add to its interest and usefulness to all those who read it. The plan is to secure men, who are experts along certain lines, to write up in the form of brief articles or papers descriptions of how certain details of their work are carried out, to furnish plans of structures which have been found of special adaptability to local conditions, and to prepare illustrated articles upon work already finished or in process of construction. It is not necessary that the work be something distinctively and entirely original, because in almost any case there will be features and details of it which may be suggestive to members of wide experience, while the whole of it would ordinarily be very instructive to the younger man of more limited experience. The Society should feel indebted to Professor Derickson, therefore, for the interest he has shown in the preparation of this paper.

The International Engineering Congress. — At a recent meeting of the Society Mr. Shaw called the attention of the members present to the matter of becoming members of the International Engineering Congress, which was held in San Francisco, September 20th to 25th. Two hundred and forty-one papers were presented, covering a very wide range of subjects. Membership in the Congress costs \$5.00, which fee entitles the

member to the general Index Volume and one other volume which he may select. It is proposed to have the volumes of the proceedings ready for distribution between now and January, 1916. The final arrangement of the subject matter of the different volumes has been agreed upon as follows: Vol. I, Panama Canal; Vol. II, Waterways and Irrigation; Vol. III, Municipal Engineering; Vol. IV, Railway Engineering; Vol. V, Materials of Engineering Construction; Vol. VI, Mechanical Engineering; Vol. VII, Electrical Engineering and Hydroelectric Power Development; Vol. VIII, Mining Engineering; Vol. IX, Metallurgy; Vol. X, Naval Architecture and Marine Engineering; Vol. XI, Miscellaneous, including Aeronautics, Refrigeration, Agricultural Engineering, Engineering Education, Heating and Ventilating, Scientific Management.

The Louisiana Engineering Society has subscribed to the complete set of the proceedings, and a number of individual members have subscribed for special volumes. It has been thought advisable to publish this statement in case there are any of our members who have neglected to subscribe and may still wish to do so. For further information address Mr. E. J. Dupuy, Foxcroft Building, San Francisco, Cal.

The State Board of Engineering Examiners.—At the November meeting of the Society Professor Derickson, Head of the School of Civil Engineering in Tulane University, took occasion to comment upon a feature of the administration of this Board with reference to the matter of holding examinations for students graduating from the Louisiana State University and from Tulane University. It appears that when a young man graduates from the Louisiana State University, he is given the opportunity to stand the examination of the State Board immediately, and thus there is no delay in the securing of his license to practice. For some reason this privilege is not accorded to the students graduating from Tulane University, and Prof. Derickson felt that the matter should be called to the attention of the Society in order that a remedy might be found, if possible. It seemed proper to bring the matter before the Society, in view of the fact that the initiative in the matter of

the formation of the Board of Engineering Examiners was taken a number of years ago by the Louisiana Engineering Society. Furthermore, the members of the Board are appointed by the Governor from a list of names submitted by this Society.

Mr. Garsaud explained that there was no intention whatever on the part of the Board to discriminate between the students of the two institutions, and that the Board was able to give the examinations to the graduates of the Louisiana State University immediately upon graduation on account of the fact that Professor Pegues, Head of the Department of Civil Engineering in the Louisiana State University, was a member of the Board of Examiners, and therefore the examinations could be held in his presence and under his direction. If Prof. Derickson were a member of the Board this same arrangement could be made at Tulane University.

When the terms of the members of the original board expired, a new list of names was submitted to the Governor for appointment, and this list included the name of Professor Derickson. Although this list was submitted to Governor Hall as long ago as January, 1915, for some reason no new appointments have been made, and matters are in a somewhat anomalous condition from the fact that the old board has gone out of power and a new board has not yet been appointed. In view of the fact that the State Board of Engineering Examiners was originally promoted by the Louisiana Engineering Society, it would appear to be advisable for the officers of the Society to take up at once and actively with the Governor the question of appointing the new board.

The Editor has requested Mr. Garsaud to interest himself in preparing, or having prepared a history of the activities of the State Board with statistics and data, which could be published in some forthcoming issue of the *Proceedings*. It should prove of considerable interest to the members of the Society, and would make a permanent record for the future of the activities of the Board during the time it has been in existence.

New Members.—The following-named gentlemen have recently been elected members of the Society:

RESIDENT MEMBERS.

Louis Jacoby, William T. Newton, James S. Sharp, Jacques de Tarnowsky, Durald F. Woods.

TRANSFER FROM JUNIOR TO RESIDENT MEMBERSHIP.

Arthur A. Diettel, New Orleans.

NON-RESIDENT MEMBERS.

Joseph P. Beranger, Santo Domingo.

Ernest A. Rose, Abbeville, La.

STUDENT MEMBERS.

Edwin F. Emmer, James B. Ewin, Eugene C. Hawkins, Edward Levi, William B. Monroe, Robert A. Pierpont, Shepard F. Perrin, Robert R. Porterfield, Green Rives, Horace M. White.

These recently elected student members are young men in the Senior Class of the different engineering courses at Tulane University. It gives us particular pleasure to welcome them into the Society and to extend to them the various facilities which the Society affords. The regular meetings, particularly, afford them an opportunity to come into contact with, and to understand the point of view of, men engaged in the active practice of their profession, and who are dealing in a purely practical way with the same sort of problems that the student is studying from the point of view of theory and principle.

Our Advertisers.—In spite of dire predictions to the contrary our journal has come through the first year of its existence with a good financial record, at least. Should we feel inclined to self-congratulation in this matter, we must also remember that a large factor in the accomplishment of the result has been the assistance rendered us by Our Advertisers. A good deal of work in engineering as well as in other lines of business goes by favor, and the adage that "one good turn deserves another" is of frequent application. We realize that as an advertising medium we are not exactly "in it" with the *Saturday Evening Post* or the *Engineering News*, but we do reach

very directly the men and firms in this locality with whom our advertisers have their largest dealings. We appreciate their cordial support during this first year and trust we may continue to merit it during the succeeding years.

The Dietzgen Employment Bureau.—It gives us great pleasure to call attention to the fact that Mr. R. H. Baumbach, local representative of the Eugene Dietzgen Co., 615 Common street, is conducting at that place an employment bureau for engineers. Engineers who may desire employment and firms having positions open may register there without charge and be notified of any vacancies or applications which may come in from time to time.

BOOK REVIEWS

Steam Boiler Economy (Second Edition.) By WM. KENT, M. E., SC. D., Author of *Mechanical Engineers' Pocket Book*. Pp. xvii+717. John Wiley & Sons, 1915. Price, \$4.50.

The second edition of this book, by the author of the *Mechanical Engineers' Pocket Book* was issued only a few months ago. The numerous improvements in boiler practice since the first edition was printed, fourteen years ago, rendered the revision not only desirable but necessary.

In addition to the material usually found in a work on Steam Boilers, there is a great deal of information regarding fuels and especially the coal fields of the United States.

The author has had a fairly broad practical experience with steam boilers; he also has a genius for collecting and arranging such data as may be found in current technical literature with the result that the latest edition of his book is a valuable reference book on the theory and practical operation of steam boilers.

W. B. GREGORY.

Valves and Valve Gears. Vol. II—Gasoline, Gas, and Oil Engines. By FRANKLIN DERONDE FURMAN. Pp. xi+444. John Wiley & Sons, Inc., 1915. Price \$2.00.

The author of this work is Professor of Machine Design at the Stevens Institute of Technology. He has written a work that is clear, concise, and complete.

Not only are the subjects of valves and valve gears treated in detail, but the fundamentals of the whole subject of the internal combustion engine are taken up and treated in a highly satisfactory manner. The use of superposed sinusoidal diagrams for laying out sleeve-valves (such as are in the Lyons-Knight engine) is novel and effective. The author has also shown himself fully conversant with practice, both domestic and foreign.

A pleasing feature of the book is the unusual clearness of drawings and diagrams. The presswork is up to the usual standard of the Wiley publications.

JAMES M. ROBERT.

Properties of Steam and Ammonia. By G. A. GOODE-
NOUGH, M. E., Professor of Thermodynamics, University
of Illinois. Pp. vii+108. John Wiley & Sons, 1915.

The justification for the preparation and publication of a new set of steam tables lies in the high degree of accuracy which has been attained in recent experimental investigations as compared with some of the data upon which the older tables were based. These points are brought out in the preface, some extracts from which are here given:

"A table of the thermal properties of a vapor should possess two characteristics, consistency and accuracy. A table is thermodynamically consistent when the tabular values are obtained from equations that are properly connected by the necessary thermodynamic relations, such as the Clausius and Clapeyron relations; it may be considered accurate if the calculated values show satisfactory agreement with trustworthy experimental data."

"The tables of the properties of saturated and superheated steam here presented are based on a new formulation the essential features of which are discussed in the first section of the book. * * * * The new theory correlates perfectly the experiments on the volume and specific heat of superheated steam; it gives values of the heat content of saturated steam that agree with those deduced by Davis from the throttling experiments; and, in general, it meets satisfactorily all the tests furnished by the available experimental evidence. The tables derived from the formulation are necessarily consistent, and they are at the same time extremely accurate."

D. A.

PAPERS AND DISCUSSIONS

MILITARY ENGINEERING.

By

A. W. JACKMAN

Member of the Society.

Read before the Society September 13, 1915.

Military engineering seemed to me to be an appropriate subject for discussion at this time when we are being told every day by the newspapers, and by the events of the day, if we read between the lines of those events, that we must "prepare." The newspaper gives little space to the engineer in the preparation plans, but does devote much space to the board of inventors, aeroplanes, and so forth. They tell us that we need an army of 200,000 or 500,000 regular soldiers for the first line of defense and twice as many volunteers or militia for the second line. When Congress gets down to business to determine on the lines of preparation to be adopted we will learn how much of the increase of the regular army is to be devoted to the engineers. We, as an engineering society, should be interested in knowing what proportion the engineers bear to the other arms of the service and how we can best assure the production of a properly trained engineer force for service in war. We can rest assured that a force of volunteer engineers will be required in time of war. At the present time the United States Engineer Corps consists of about 212 commissioned officers and 2,000 enlisted men. The total enlisted strength of the army is about 85,000, which includes the Medical Corps, Quartermaster's Corps, Ordnance Department, Signal Corps, and all the miscellaneous detachments such as that at West Point, and the bands. On the same basis there would be required in a regular army of 500,000 men about six times the present strength, and for the volunteer army of 500,000 we would need as many more. Under the present system it is extremely hard for a civilian to break into the Engineer Corps of the regular army as an officer, though the law does provide a way in which it can be done. I assume

that we would all want to be officers, and it is no more than right that the man who makes engineering his profession should be the logical man for a commission in a volunteer engineer corps.

During the Spanish-American war I was a private in a volunteer infantry regiment. When we reached Tampa on our way to Cuba some one in Washington had discovered that the army was very shy on engineers and some days before we embarked for Cuba each company in the regiment was called on to detail a few men to make up a provisional company that would be drilled as an engineer company. That company afterward took part in the Porto Rico campaign.

If war should come on us to-day, and I hope that there is no more chance than I can see now, we would be in bad shape for not only infantry, cavalry and artillery, but for engineers. Now is the time that steps should be taken to prepare for the emergency. It does not take so much time to arm and train an infantry man; it takes a little longer to put a cavalry man in the field and a little longer still for the artillery, while I believe that a properly trained and equipped engineer force would take longer than any one of the three. The first thing, of course, would be the officers to train the men. And among the subjects in which the men would have to be trained are: I was going to give a list of subjects, but I think the best way to describe what the army engineer must do is to quote from an article in *Professional Memoirs*, which I read some years ago. This article defined the duties of the engineer by saying that "the engineer must be prepared to do anything." I think that just about describes the situation. A short time ago an article appeared in one of the engineering journals describing some of the work done by engineers during the present war. This article described how a railroad bridge was repaired and how a tunnel that had been blown up was cleared so that trains could be run. The engineer troops with a division are known as the pioneer battalion; the mounted pioneer battalion and the pontoon battalion. The pioneer battalion is equipped to do reconnaissance, field entrenchments, mining or demolition work. Reconnaissance is the military term used to designate the work of troops or

individuals when gathering information in the field and for engineer troops might also be described as military topography. Reconnaissance must be done rapidly and without the refinements of the surveyor. An officer is sent out to get the information for the preparation of a map showing the field of which the commanding officer wants information. Suppose it is a road of which he wants to know. The engineer starts out on horseback with his field sketching case. He must produce a sketch of the road, reporting on the general nature of the country, with the difficulties to be met with in marching. The sketch is made on a scale of 1, 2 or 3 inches to a mile and using either horses paces or a time scale for distance. The sketcher sights to the first bend in the road and draws a line in that direction. His sketching board is strapped to his left arm and is equipped with a compass and ruler arranged so that when he gets to the point at which he sighted he can orient his board, sight to the next station and go ahead. As he proceeds along he is supposed to note the features to each side of the road. As a rule he estimates the distances of the offsets. His report covers such items as roadway—width, condition, material, material for repair, grades, defiles, fences. Bridges, material, length, breadth and height above the water, piers and location of any fords near by. He makes note of anything that might retard the usual rate of march. He gives a description of any towns through which the road passes, a general description of the country, the rivers, streams or canals, the halting places, camping grounds, railroads, telegraph lines and so forth. Under each of the headings I have given he is supposed to report the salient facts. For instance, when he reports that a certain town is on the X, Y, Z railroad, he should also state the gauge of the road; where it runs to and from, whether it is single or double track, whether the rails are iron or steel; weight, laid on chairs, tie plates or not; fastened by fish plates or angle-irons; ballast; kind of ties and how far apart they are laid, location and length of sidings and if there are conveniences for loading or unloading troops, animals and supplies and almost a thousand other points.

In order that he may make a map or sketch of road or position that will be intelligible, the engineer must know how to

determine the true north, the use of clinometer, or a substitute for one, the different methods of approximately determining the distance of one point from another, such as by pacing, by counting his horses' paces, by the elapsed time, by estimation and by intersection, which is done by taking the azimuth of the unknown point from two known points. He must be able to put his notes on paper in the shape of a map and may have to improvise rule and protractor. The scale of military maps is represented by the ratio that any unit on the map bears to the same unit on the ground, that is, instead of saying that the scale of a certain map is 1 inch to the mile, the military map would have the scale expressed a $1/63,360$, 63,360 being the number of inches in a mile. He must know how to contour so that after his map is made the artillery man can look at it and see at a glance whether or not two points are mutually visible, or whether if his batteries are planted at a certain point, they will be visible to the enemy. In order to do all these things well, he must know how they are done with the best instruments, and must be trained in the use of those instruments.

With an army on the march, the engineer is frequently called on to build bridges, or repair those in place. For this purpose he must know the loads that it will have to bear just the same as his civilian brother, only in this case it is expressed in terms of "infantry in column of fours," cavalry or artillery. He must know the safe loads for the different materials and, above all, must know how to improvise, if necessary, a bridge from the materials at hand. There is no time to wait until the steel can be fabricated. He must use what he can. In China, in 1860, they used a trussed ladder bridge for crossing the many canals. Two ladders were trussed so that the rungs were vertical and on top was placed the roadway. As the canals were about 20 feet or so wide this answered very well. There are many ways of making so-called spar bridges and always the pontoon bridge. This is really a bridge composed of boats supporting the roadway. One advantage of this kind of a bridge is that you don't have to calculate the amount of reinforcing steel required. Pontoon bridges are built by successive bays, where the boats are placed in position one after the other and the roadway built

progressively, by parts, where two or more bays are placed in position at once, and by conversion. In this method the entire bridge is built alongside the bank and then the end up stream is cut loose and the current swings the bridge across. I remember studying this method some years ago, but I cannot find it in the latest manual. Besides the pontoon, spar and ladder bridge the engineer may have to build a bridge when he has nothing but a number of empty barrels, a few nails, a few feet of rope and some trees. By the way, a very fair pile driver can be made from the roadway materials of a pontoon bridge outfit. Then he may be called on, by conditions, to build a cantilever or truss bridge—you never can tell.

Sometimes he has to build roads, but as a rule they are not hard surfaced. About all he can do is see that they are well drained. He may have some cuts and some fills to make. It is mostly earth work, unless the army happens to be operating in a rock country.

Railroads is another subject he is supposed to know—how to locate and how to build in the shortest time—always with the material at hand. And operation as well, from running the engine, with the remedies for injector troubles to making up a scientific time table. And that reminds me of the time that I reported for duty at Fort Hamilton; the commanding officer there had a habit of be-deviling the second lieutenants on arrival, and he did not miss his chance on me. He wanted to know if I could run a locomotive, and if I could read and write.

The engineers' real work, however, comes when the two armies face each other and settle down to trench warfare, or where one besieges the other in a fortified place. In the hasty preparation of field works it is an accepted theory that they are to be constructed by the same troops that defend them. The engineer, however, makes the necessary changes to make the hasty trenches conform to a scientific plan. The first trenches are made as best they can, under fire as a rule, and then the engineer suggests the changes to be made. Field fortification is divided into hasty entrenchments, deliberate entrenchments and siege works. In this subject, consideration is given to the

object for which the trench is constructed, whether for temporary cover, defensive, or siege. The profile of the trench is determined by the above and also whether it is to resist rifle fire only or rifle and artillery fire. In trenches for purposes of offense they are adapted to give exit over the parapet for the forward movement. Sometimes they give cover for a man prone, or kneeling, or standing. In defense the trench almost always gives cover for a man kneeling or standing. In field fortification the term "trace" usually designates the horizontal projection of the interior crest. The "trace" will usually follow the lines of best natural cover or those which determine the strongest natural position. It is important in locating a line of trench to avoid a sky line; to occupy the military crest or a line in advance of it, and to preserve communication to the rear under cover. The first requirement of a good position is a clear field of fire and view to the front and exposed flanks to a distance of 600 to 800 yards or more. The length of front should be suitable to the size of the command and the flanks should be secure. It should be a position that the enemy cannot avoid, but must attack or give up his mission. Dummy trenches are sometimes used to cause the enemy to expend his ammunition without result and protect the true fire trench. Trenches are protected in front by obstacles of different kinds designed to delay the enemy while exposed to the fire of the trenches. Obstacles consist of wire entanglements, abatis, which are trees felled with the branches pointing toward the enemy, military pits and other forms, including the flooding of a considerable area so that it forms a barrier.

In sieges the first trench or parallel will be approximately parallel to the position of the enemy; this trench is pushed forward by sapping. A sap is a trench starting from a parallel and somewhat inclined toward the position of the enemy. It cannot be dug directly toward the enemy because in that event his fire would sweep the length of the trench instead of passing it at right angles. Still it must be between the two extremes so that it will advance the lines. When it has reached as far as possible, another parallel is started so that it will parallel the enemy's lines. This operation may be repeated many times

until near enough to the enemy's position to take it by assault. Approaches are called saps and the operation of digging them is called sapping; the skilled men are called sappers and the end at which the digging is being done is called the sap head. Siege work also takes in mining, the main object of which is to get under the enemy's position and blow it up, thus opening a breach through which the position can be taken by assault.

In some of the foreign armies the engineer service is divided so that the work of bridging falls on a special division, and bridging is the entire work of the division, another division has charge of the railroad work, another the road work, all different lines of work being divided so that a special division of the engineers has that one thing to look after. In the United States, however, the organization is such that the engineers may be called on at any time to do anything.

While it does not come under the head of field engineering, the method of getting the ranges for the big seacoast guns is properly engineering work. Two methods are followed, the horizontal base or the vertical base systems. A base line is laid out and the length accurately determined. At each end of the base line is an observing station with an angle measuring instrument. These two instruments sight on the same part of the target at the same instant and report the azimuth of the target from their stations to the plotting room. In the plotting room we have a plotting board on which the base line is located with reference to the directing gun of the battery. When the observers at the stations report a man connected with the observers by telephone moves the arms centered at the ends of the base line on the plotting board to the azimuth reported. The intersection of the two arms determines the position of the target at the time the observation was taken. A number of observations are taken so that the speed and direction of the target are known. Then knowing the speed and direction of the target, we can predict where it will be at the end of say 30 seconds from the time of the last observation. This point determined, the arm that is centered at the position of the directing gun on the plotting board is swung over the point and the range and direction from the directing gun to the predicted point are read. This information

is transmitted to the gun. The gun commander has a range table which shows how long it takes the projectile to travel the different ranges. He aims his gun at the point where the target will be at the end of the predicted time and fires his gun enough ahead of the predicted time so that the target and projectile both arrive there at the same time.

In the vertical base system there is only one observing station, and the range finder automatically solves the right triangle in which one side is the line joining the base of the tower in which the range finder is located and the target, and the other is the height of the instrument above that line. The hypotenuse being the line of sight. This instrument gives the range and direction of the target, which are transmitted to the plotting room and from then on the operation is just about the same as in the horizontal base system. In both systems corrections must be made for the force and direction of the wind and the humidity as well as for the velocity of the projectile. In the vertical base system correction has to be made for height of tide as well.

The outline of the work and knowledge required will, I hope, prove the necessity of preparation beforehand, and that preparation, while it will be made easier by thorough study of the theory needs "practice" to bring out the weak points. I feel that I am voicing the sentiment of the Society when I say that if Congress will provide the way and means we will do our best to be thoroughly prepared.

A SUGGESTED FORM OF CONSTRUCTION FOR HIGHWAY BRIDGES IN LOUISIANA: THE REINFORCED CONCRETE ARCH.

By

DONALD DERICKSON, C. E.,
Member Louisiana Engineering Society.

At the present time the subject of "Good Roads" is a live question in this state. As well designed and properly constructed bridges are an essential factor in the development of our highway system, it may be of interest to consider the reinforced concrete arch for locations where the water-borne traffic does not necessitate movable structures, and where the span is too great for girder construction.

Some of the advantages offered by the reinforced concrete arch as compared with bridges of steel may be stated as follows:

Durability: A well planned and executed concrete arch should be permanent, while bridges of steel are of uncertain life. One well-known authority gives the life of a steel railroad bridge at not far from twenty years. With the lack of attention accorded the average country highway bridge, combined with the atmospheric conditions prevalent in Louisiana, it would seem that a longer period of usefulness might not be reasonably expected. Especially is this true when the steel bridge is the result of the method often employed, in calling for bids and accepting the lowest price on plans and specifications prepared by the bidder without having them examined by a competent engineer.

Appearance: The arch is pleasing to the eye and lends itself to artistic treatment, while the steel truss is not inherently attractive and decoration does not improve its appearance.

Local Conditions: As a portion of the labor in concrete construction is unskilled, it may sometimes be drawn from the locality, and where lumber for the forms as well as sand and gravel for the concrete are to be had at low cost in the neighborhood, advantage may be taken of such conditions with a corre-

The writer acknowledges with thanks the assistance rendered by Mr. E. H. Coleman, M. E., Mem. La. Eng. Soc., in the preparation of this paper.

sponding saving in cost, and the money spent for the steel and cement would be the only part of the total expended to leave the state.

Cost: The first cost of a reinforced concrete arch as compared with a steel span depends so much upon local conditions that each case must be investigated separately. In some locations the arch may be built cheaper than a first-class steel span, but it is not probable that it can compete in this respect with the excessively light and inadequate structures so often found in rural districts.

Engineering Service: The design of a reinforced concrete arch bridge requires the services of an engineer and its successful completion makes necessary constant and close inspection. In the case of a steel span, unfortunately, too often, no plans or specifications are prepared except those of the bidders and accordingly no restrictions are placed upon the bidders as to load capacity, unit stresses, and other essential requirements of an adequate bridge. Frequently engineering services are not made use of in protecting the buyer from errors in design, fabrication and erection, by the party securing the contract. It is true that under such conditions the community is quite apt to secure a bridge of low first cost and it is equally true that, as a rule, the bridge companies give a full return for the money received. The fault is not with the contractors, but with the system that makes possible the selection of a bridge wholly on the basis of least first cost and through ignorance eliminates the services of an engineer in order to save his fee.

Reinforced concrete arches may be divided into two types as represented by the fixed arch without hinges and the three-hinged arch having hinges at each abutment and at the crown.

The fixed arch is separated into two groups according to its method of reinforcement; in one the reinforcement is composed of rods located near the soffit and extradosal surface. This is the form most commonly used in the United States. The other is known as the Melan arch. Its reinforcement is formed of structural steel ribs consisting of upper and lower curved flanges connected by lattice bars, and extending from abutment

to abutment, the whole forming a light structural steel arch embedded in concrete.

Again the concrete arch may be classified according to whether it has an open or solid spandrel, the spandrel being the space between the arch ring and the roadway surface. If the spandrel is solid it is formed by walls which retain the earth fill upon which the roadway rests. In the case of the open spandrel, the loading is delivered to the arch by means of columns or piers which support the superstructure upon which the roadway rests. The open spandrel generally means lighter construction and by its use the arch ring may be divided into two or more ribs or parallel arches. The use of the open spandrel seems to be increasing and is quite general. It is stated by Professor McKibbin in "A Treatise on Concrete, Plain and Reinforced" by Taylor and Thompson, that "Filled spandrels may be therefore limited properly to bridges with solid arch rings of short spans, say not over eighty feet, and those having a rise of less than one-tenth of the span where the cost of form construction prohibits an open design."

The theory upon which the design of the fixed arch is based is known as the Elastic Theory. It is more difficult in its application than the theory of statics employed in the design of the three-hinged arch. It is assumed that the ends of the arch are rigidly fixed or, that if there is any movement, it is slight and exactly known. Where the local conditions are favorable to securing good foundations for the abutments and sufficient rise for the arch, practice, as expressed in the various papers of the profession, is in favor of the fixed or continuous arch as compared with the three-hinged. It is built in great numbers in this country while comparatively few of the other type have been constructed. As has been previously stated the elastic theory is now quite generally recognized as the proper method of analysis for the fixed arch. It is set forth in an admirable manner in Taylor and Thompson's treatise previously mentioned; in Turneure and Maurer's "Principles of Reinforced Concrete Construction," and in Professor Steinman's recent translation of Professor Melan's comprehensive work on arches. Many articles of value are to be had in current and back numbers of

engineering periodicals, as well as the transactions of the engineering societies, descriptive of some of the numerous reinforced concrete arch bridges built in this country and abroad.

The three-hinged arch, as the name indicates, has hinges at each abutment as well as at the crown. As a structure it is statically determinate and the theory involved is well covered in such standard books as "Roofs and Bridges," by Merriman and Jacoby, and "Modern Framed Structures," Johnson, Bryan and Turneure. The theory is easily understood, though somewhat long in its application. The advantage of the hinges lies in the accommodation afforded any movement of the arch caused by expansion and contraction produced by changes of temperature, and any slight yielding of the abutments. The arch being free to turn about the hinges, no bending moment is produced at these points other than that caused by the friction of the hinges which is small and can be estimated. Accordingly the equilibrium polygon for any position of the loading upon the arch must pass through the hinges. The hinges are formed by bearings which press against a cylindrical steel pin, or by ball and socket joints; the former is simple and cheaper than the latter, which, however, possess the advantage of eliminating the ill-effects of any error in setting, while the pin bearing should be exactly perpendicular to the arch ring. For this reason the ball and socket hinge has been employed where heavy thrusts were to be provided for.

In outline the three-hinged arch is thicker at a point about midway between the crown and the abutment, and accordingly it is not as pleasing in appearance as the fixed arch. The hinges interrupting the continuity introduce an element of some uncertainty as regards the durability, and their expense offsets the saving in material effected by their use. Also since they allow some movement the arch is not as rigid as the other type. These are some of the points urged against this form of construction, but there seems to be a fixed arch for locations where the rise is less than one-tenth of the span, and where soil conditions are not favorable to unyielding abutments. With an arch of low rise the temperature stresses must receive careful consideration unless hinges are provided. Just what range of temperature is

to be provided for, is to some extent uncertain, depending upon the locality and whether the arch has solid or open spandrels, but investigations tend to indicate that the change of temperature is real and of importance. Bulletin No. 30 of the Iowa State College of Agriculture and Mechanic Arts, gives results of investigations extending over two years on two arch bridges in Iowa.

The hinges can be protected from corrosion, and the lack of rigidity which caused the three-hinged steel arch bridges to lose favor with engineers in comparison with the two-hinged, which has hinges only at the abutments, is obviated largely by the weight of the concrete.

Although the three-hinged masonry arch was built as early as 1873 in Germany, it was only about ten years ago that the first one was built in this country, in Brookside Park, Cleveland, Ohio. This arch was built without reinforcement, the span being ninety-two feet and the rise nine feet, the soffit being solid or barrel shaped, although the open spandrel, ribbed arch, adapts itself more readily to the use of hinges. The three-hinged reinforced concrete arch has been built in Germany for both railroad and highway purposes, while in America its use has been limited to highway traffic, including loads from electric railway cars. Although this class of arch is being built in increasing numbers, the descriptive articles available that are of value are few as compared with the valuable material relating to the no-hinged arch whose use is so general. Possibly this is true because the theory is so well understood.

In the preparation of an engineering design, no matter how simple, it is advisable to study what others have done. Accordingly the following list of references has been prepared, which are to be found at the libraries of the Louisiana Engineering Society or of Tulane University:

A Treatise on Concrete. Plain and Reinforced. By Taylor and Thompson. See Chapter XXXII, by Professor Frank P. McKibben.

Plain and Reinforced Concrete Arches. By Professor J. Melan. Authorized translation by Professor D. B. Steinman.

Three-Hinged Masonry Arches, Long Spans Especially Considered. By David A. Molitor, Trans. Am. Soc. C. E., 1898, Vol. 40, page 31.

Concrete Bridges, Some Important Features in Their Design. By Walter M. Smith, Sr., and Walter M. Smith, Jr., Trans. Am. Soc. C. E., 1914, Vol. 77, page 695.

The Design and Construction of Four Reinforced Concrete Viaducts at Fort Worth, Texas. By S. W. Bowen, 1915, Vol. 78, page 1207.

Slate Creek Bridge—Building a Concrete Arch Bridge Fifty-six Miles from Rail. Between Plumas and Secora Counties, California. Eng. News, November 19, 1914. Vol. 72, page 1018.

Three-Hinged Skew Arch Over the Berlin-Spandau Canal in Germany. Eng. News, December 4, 1913. Vol. 70, page 1127.

A Reinforced Concrete Arch Bridge with Separately Moulded Members. Over San Louis Rey River, near Ocean Side, California. Eng. News, April 13, 1911. Vol. 65, page 460.

The 320 Foot Reinforced Concrete Three-Hinged Arch of the Grafton Bridge, Auckland, New Zealand. Eng. News, August 4, 1910. Vol. 64, page 113.

A Three-Hinged Arch Covering Over a Canal in Paris, France. Eng. News, September 15, 1910. Vol. 64, page 290.

Three-Hinged Reinforced Concrete Arch Bridge, Los Angeles. Eng. Record, August 13, 1910. Vol. 62, page 181.

Masonry Arch Bridges of the World Over 175 Foot Span. Eng. News, September 2, 1909. Vol. 62, page 254.

An Economical Long Span Reinforced Concrete Highway Bridge. Over Vermilion River at Wakeman, Ohio. Eng. Contracting, February 24, 1909. Vol. 31, page 140.

A Three-Hinged Masonry Arch with Metal Joints and Concrete Superstructure. Over Branla River, near Lyons, France. Eng. News, September 10, 1908. Vol. 60, page 278.

A Light Three-Hinged Concrete Arch Bridge in Rock Creek Park, Washington, D. C. Eng. News, May 21, 1908. Vol. 59, page 555.

A Skew Three-Hinged Reinforced Concrete Arch at Denver, Col. Eng. News, April 2, 1908. Vol. 59, page 362. See also—

A Three-Hinged Reinforced Concrete Arch Bridge in Denver, Col. Eng. Record, March 21, 1908. Vol. 57, page 336.

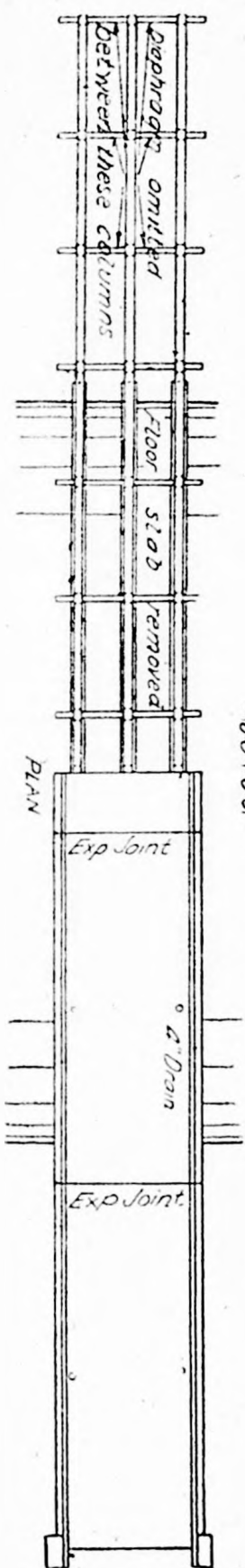
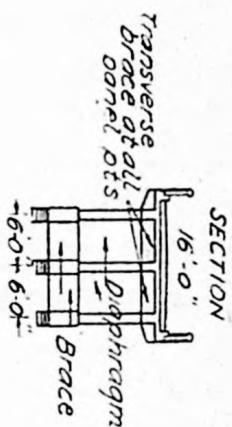
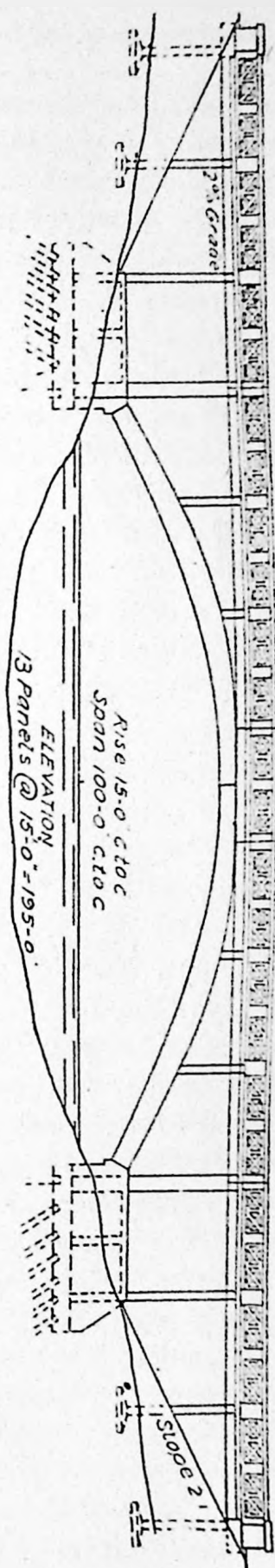
Some Three-Hinged Concrete Arches in Germany. Eng. News, May 2, 1907. Vol. 57, page 48.

Three-Hinged Concrete Arch Bridge, Brookside Park, Cleveland, Ohio. Eng. News, May 10, 1906. Vol. 40, page 507.

A Concrete Steel Three-Hinged Arch Bridge at Laibach, Austria. Eng. News, July 16, 1903. Vol. 50, page 61.

Table No. 100 on page 722 of Baker's *A Treatise on Masonry Construction*. This is a list of twenty references relating to European three-hinged arches. Reference No. 11 of this table, relating to the failure of the Maximilian Bridge, Munich, Bavaria, which was wrecked by slipping on the hinges is most instructive.

The soil of certain parts of Louisiana offers but poor material for foundations and piles must be resorted to in some locations. Also the topography is such that an arch bridge will naturally be of low rise, and the changes of temperature to which the structure would be subjected are considerable. All are conditions which, if arch construction were to be employed, would seem to indicate the three-hinged type. As the references of any value relating to three-hinged arch bridges that have been built in rural districts for highway traffic are few, a design has been prepared for conditions which are more or less typical of some sections of our state. This design is not submitted as being the best that can be prepared, and there are doubtlessly many features open to criticism that might be changed for the better in another design. While the design



has been worked up with some care for certain assumed conditions, it is only intended to offer a suggestion of what might be done along similar lines under actual conditions and to give an idea of the quantities involved and the appearance of the structure.

The conditions assumed and upon which the design is based are as follows: Location: The location is taken as a point where a well-traveled highway crosses a slow running stream, which sometimes overflows its banks and makes desirable an approach that will obstruct the passage of the water at flood as little as possible, and it is further assumed that tests indicate that the soil under the column footings is capable of safely sustaining a load of 1,350 pounds per square foot, but that the abutments should rest on piles, a forty-foot pile being capable of safely sustaining an allowable load of 12 tons.

Loading: The loading to be considered is of two kinds, vertical and horizontal. The former would consist of dead load, live load and impact, while the latter would be made up of wind pressure, and water pressure during high water. The dead load is formed by the weight of the structure and the material forming the road surface; to provide for the roadway a fill 12 inches deep and weighing 100 pounds per square foot was assumed, though probably this is somewhat excessive.

Live Load: The live load for the floor system and columns was taken as a 15-ton traction engine with wheels spaced 6 feet, and axles spaced 11 feet apart, the weight on each of the front wheels being 5,000 pounds, and 10,000 pounds on each of the rear wheels which have tires 22 inches wide. This is the loading used by the Iowa Highway Commission. In the design of the floor slab it was assumed that each wheel load was distributed over a strip two feet wide in the direction of the traffic and four feet at right angles to it. For the arch, a live load of 100 pounds per square foot was assumed as applied at the columns in such a manner as to produce the greatest stress in the arch. For convenience it was considered that the loads were transferred to the columns by the stringers acting as simple beams and that any column might sustain its maximum live load without there being produced either positive or negative loads on

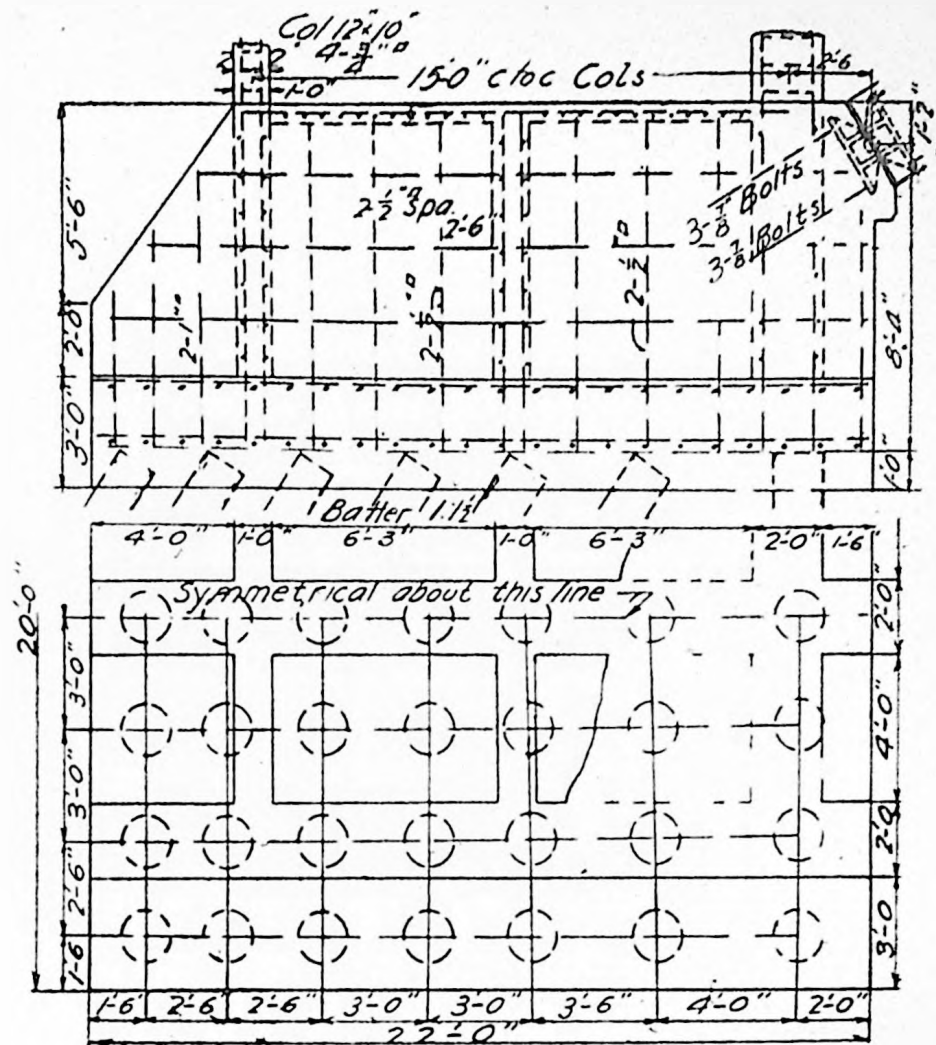
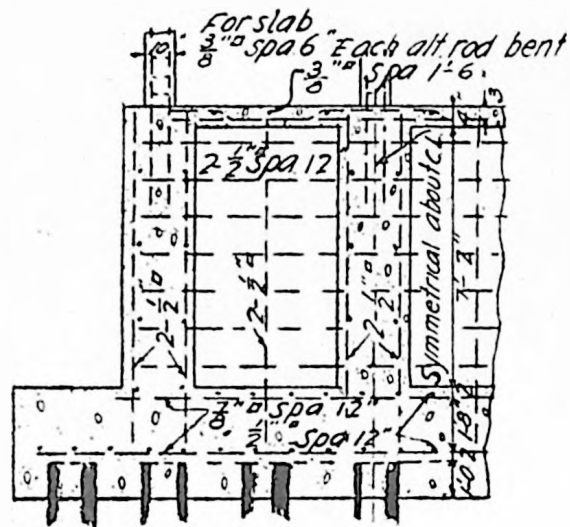
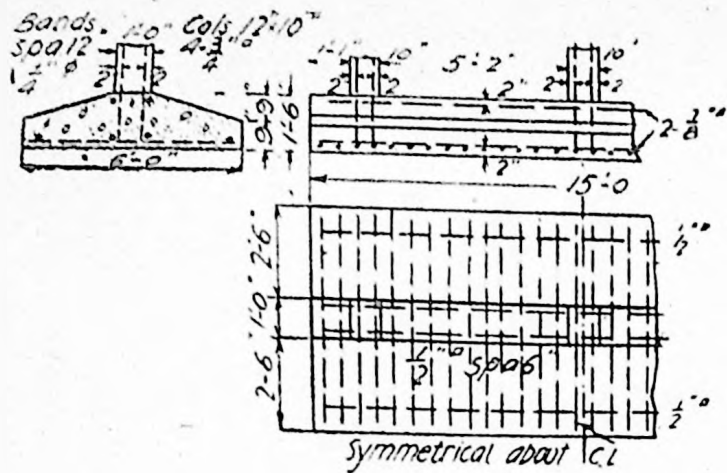
any of the other columns; such a condition is, of course, impossible owing to the continuity of the stringers. But the actual moving loads to be sustained would be of such an uncertain character that it does not seem that it would be advisable to go to the labor of preparing influence diagrams for the upward and downward pressure on the columns based on the theory of the continuous beam, though such refinement might give a more satisfactory design for a definitely known train of loads, provided the change in elevation of the supports caused by the deflection of the arch under the action of the loading was also known. The live load of 100 pounds per square foot is a bit high, but allows for some future increase. Impact: No impact loading was assumed. Tests in Illinois and Iowa on highway bridges with concrete floors indicate that its effect is small.²

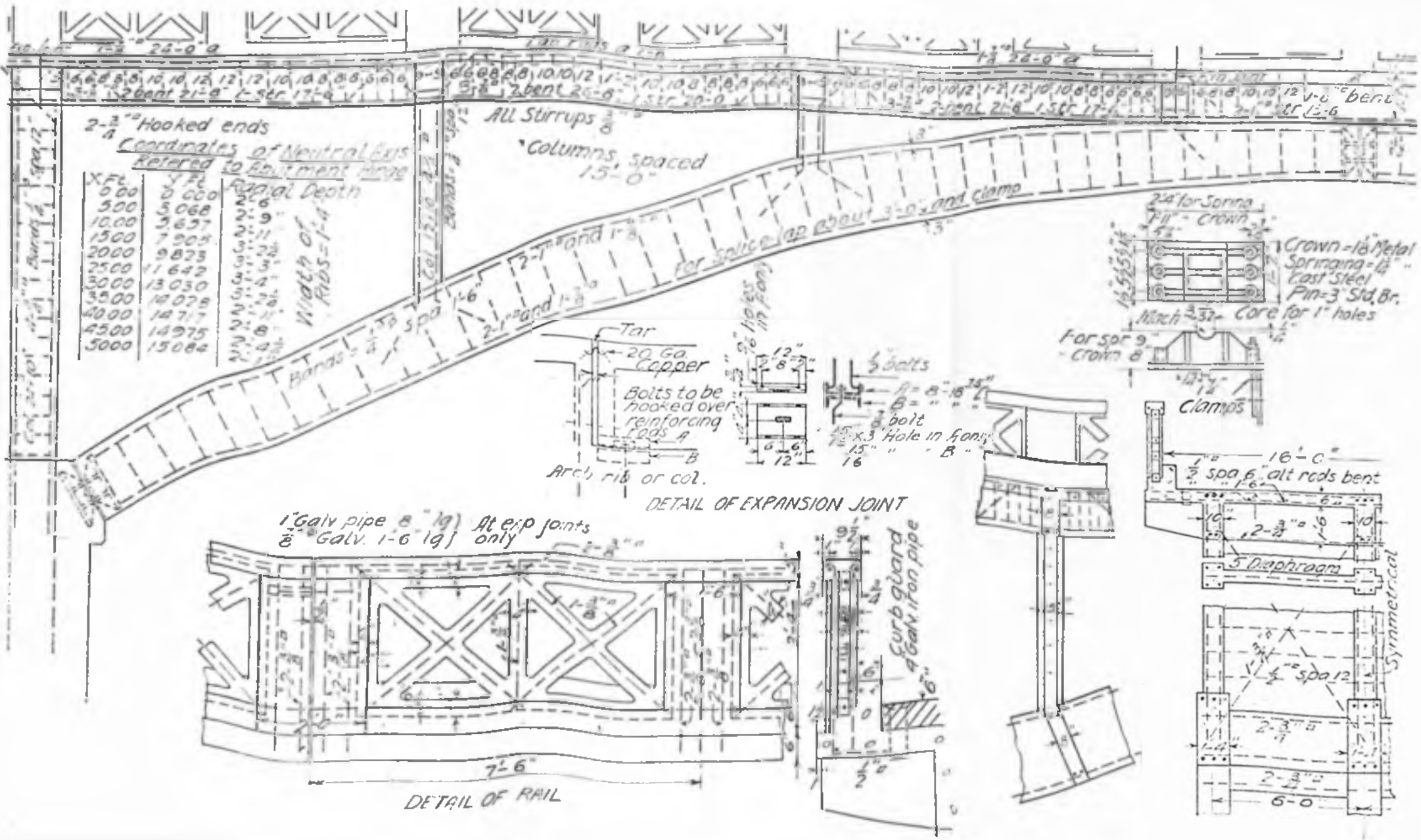
Lateral Forces: Wind and water pressure could be accurately provided for if they were definitely known. To do so would necessitate a knowledge of the elevation attained by the water on the arch and the velocity of the current. The wind velocity might be assumed, but its pressure would still remain somewhat uncertain on the structure as a whole. Accordingly resistance to the lateral forces will be offered by placing cross-braces between the arch ribs and between the floor stringers at all panel points, and these transverse braces will be made as deep as the construction of the arch ribs and stringers will allow. Also diaphragms will be placed between the columns on the arch and those on the abutment adjacent to the arch. This will serve not only to resist the lateral forces mentioned, but to distribute the floor loading equally to the arch ribs and cause them to act in unison.

Unit Stresses: The allowable unit stresses are in accordance with the recommendations of the "Joint Committee."[†] In the arch ring the compressive stress on the concrete, due to axial thrust, was not allowed to exceed 450 pounds per square inch, while the combined stress caused by flexure and direct stress due to the eccentricity of the latter was permitted to go

Structural Engineering, by J. E. Kirkham. Myron C. Clark Publishing Co., New York.

[†]Trans. Am. Soc. C. E., December, 1914. Vol. 77.





as high as 650 pounds per square inch. The steel castings for the hinges were designed for a fiber stress of 16,000 pounds per square inch and an allowable bearing against the pin of 24,000 pounds per square inch.

The bending moments in the floor slab and stringers, except the stringers at the crown, were computed as for simple beams and reduce 20 per cent, while the shear was increased the same amount on account of continuity. The effect of the continuous beam action in the floor system in producing bending moment in the columns was considered in their design. Also the additional bending moment set up in the arch ring due to the flexure induced in the columns, as well as the increase in the soil pressure under the column footings was estimated and allowed for. The moment due to the friction of the hinges was estimated and combined with the other forces resisted by the arch ribs. Any movement of the arch under live load, change of temperature, and possible yielding of the abutments was provided for by placing joints in the deck at the crown and at the abutments.

The curve of the neutral axis was determined by first designing the superstructure and estimating its weight. This was applied at the bottom of the columns along with the weight of the pavement, and the column reactions produced by a live load of one-half the specified intensity covering the full span. An assumption was then made for the weight of the arch rib taking the greater thickness of the rib at the quarter point and the estimated weight of the casting at the crown into consideration. This weight was applied at the columns and intermediate points. For this combined loading an equilibrium polygon was drawn which would pass through the hinges, and the straight lines of the polygon were replaced by curves and the coördinates scaled in sufficient number to reproduce the curve.

The rods forming the reinforcement of the arch ribs are held rigidly in place at the hinges by being clamped to short pieces of round rod with threaded ends, which pass through the casting; by turning up the nuts on the short rods, the reinforcement is brought to a firm bearing. This is no doubt an unnecessary refinement, but it adds little or nothing to the cost and

gives an additional factor of safety against the rib slipping from the casting. By providing numerous small holes in the hinge castings, metal lath can be attached and the castings surrounded by cement plaster, leaving a space of half an inch at the pin for movement of the arch. This would conceal and protect the castings from corrosion. The pins may be protected by pouring molten lead so that it would form a collar one inch high and entirely surround the exposed portions of the pin.

Camber: In order that the crown thrust under the maximum load may have a lever arm equal to the assumed rise in the computations, the assumed value of the rise must be increased by an amount equal to that which the crown will sink under the dead load when the centers are struck, and when the full live load is in place with the greatest drop in temperature that may be expected below that existing at the time of construction. Assuming that the combined dead and live loading will produce an average unit stress of 450 pounds per square inch, and that the drop in temperature of the arch rib will be as great as 40 degrees, the deflection of the crown would be about one inch. Accordingly the vertical coördinate to the neutral axis, at the crown, should be increased one inch, and other points in proportion. The abutments were designed with reinforcement in order to make them as light as possible, and to keep the resultant pressure of all loads near the center of the base. It is quite possible that it might have been cheaper to eliminate the steel and use more massive construction of plain concrete.

Estimate of Material and Cost: The material has been estimated with care and it may be of some value in forming an idea of the quantities involved in similar structures as it is not probable that a better or less efficient design for the same conditions would result in any great change in the total, but it should be remembered that trestle approach at each end has been included. On the other hand the cost depends upon so many conditions prevailing at the time as well as the location, that a cost estimate for the assumed conditions would be of but little value for an actual case. However, feeling that some value might be derived from such an estimate when made by a contractor experienced in reinforced concrete construction and

familiar with our local conditions, Mr. John Riess, member Louisiana Engineering Society, kindly consented to assign probable unit prices for the material and quantities estimated, which are as follows:

Concrete, 1:2:4 mix—390 cu. yds. @ \$10.00.....	\$3,900.00
Steel reinforcement, 41,500 pounds @ \$0.03.....	1,245.00
Steel castings, 6,100 pounds @ \$0.085.....	518.50
Pins and nuts, 300 pounds @ \$0.05.....	15.00
Bolts and nuts, 700 pounds @ \$0.04.....	28.00
Structural steel, 450 pounds @ \$0.05.....	22.50
Metal curb edging, 390 lin. ft. @ \$0.15.....	58.50
Piles, 3,920 lin. ft. @ \$0.45.....	1,764.00
Excavation, 353 cu. yds. @ \$1.00.....	353.00
Incidentals	20.00
Total	\$7,924.50
Bond and Liability Insurance.....	160.00
Total	\$8,084.50
Contractors Profit @ 20%.....	1,617.00
Total	\$9,701.50
Engineering, @ 6%.....	582.00
Grand total	\$10,283.50

A question that might well be asked is, what would a steel bridge have cost under the same conditions? This is probably better answered by referring to an actual case. Last year the writer designed two bridges each having a steel span of 100 feet and concrete piers. The approaches were of treated timber on pile bents of about the same number and span as the approaches in the assumed problem, as was also the loading, except that some impact was included. While the location gave conditions about the same as those assumed, the allowable soil pressure was much more favorable and was taken as high as 8,000 pounds per square foot. Bids for both bridges were given as \$15,775, \$19,912, and \$24,000. Assuming that one bridge

would cost half as much as was bid for both, would give about \$7,887, \$9,956, and \$12,000. However, in making comparison it should be remembered that in the case of the steel bridges the prices included some fill for the approaches, while had the soil pressure of 8,000 pounds been assumed in the problem the use of piles would have been obviated and the size of the footings reduced.

In closing it may be stated that it is not the intention of this paper to advocate the indiscriminate use of reinforced concrete for our highway bridges. In locations where movable bridges are required on account of navigation their use is precluded. For long spans the abutments are an expensive item and it would seem that a well designed steel structure would be more suitable. In fact the particular class of bridge to be employed in any location is a matter that should be considered with an open mind free from prejudice in favor of either steel or concrete.

As has been stated; this paper is only intended as a suggestion and as such it is hoped that it may be of some interest.

DISCUSSION UPON MILITARY ENGINEERING.

THE PRESIDENT: In regard to the Coast Artillery, we have with us First Lieutenant Thomas, of the Coast Artillery Corps, N. G. N. Y. Maybe he can tell us how to hit a ship.

LIEUTENANT THOMAS: Mr. President and Gentlemen: The latest example of ships against coast fortifications, I believe, is at the Dardanelles, and it has resulted, to judge from newspaper reports, very much in favor of the fortifications.

I don't know that I can give you a very accurate description of the range finding apparatus, as used by our Coast Artillery. as, like most other branches of the service, there are changes about every fifteen days. In general, as the author of the paper said, we have two general ways of getting ranges: one by the horizontal base and the other by the vertical base. The horizontal base is, of course, very much more accurate, as then we can have a base line of any length we like; usually, not less than 2,000 feet, whereas with the vertical base, the base line is restricted by the height of the instrument above the water. In all stations, where possible, the vertical base is used as a secondary method in case the horizontal base should be out of commission.

The general method is to lay out a base line exactly measured, and establish an azimuth instrument on each end, and when the Government has money enough, these azimuth instruments are also equipped as vertical base range finders. This, however, is not the case in very many stations at the present time.

The plotting board is now located as the directing point of the battery, the battery usually consisting of two guns, although in some cases there are three and even four. We formerly used one of the guns as the directing point of the battery, but in the new stations, we use the instrument in the battery commander's station as the directing point. The plotting board is laid out to scale of 300 yards to the inch, and quite frequently, for seacoast fortifications, there is superimposed upon the plotting board, a map of the field of fire, with turns of the channel

and other points where vessels are compelled to pass, very accurately located as to range and deflection.

For the detail work of finding the ranges, we have what we call the "Time interval bell." This is controlled by a master clock, which rings a bell at regular intervals. At the present time we are using 30 seconds. This bell strikes three blows at each interval, and rings in each observing station, battery commander's station, and at the battery. All readings are taken at the third stroke of the bell. A man who is operating the azimuth instrument follows the target all the time. At the third stroke of the bell, he stops his instrument, and the reader reads the azimuth. He wears a telephone head set, and as he reads, he talks it into the telephone, and the man at the pointing board, who sets the arm corresponding to this instrument, gives this azimuth reading, and sets the arm accordingly.

A well trained crew will make very quick work of this range finding; in fact, I have had a range section working on 15 second intervals, have the corrected range and deflection at the guns in less than six seconds. We are not trying for so much speed now, under the 30 second interval, as we are plotting more after the method used for control of mortar fire.

The range board consists usually of a semi-circular board. On the straight edge of the board is laid out to scale, the base line. On the ends of the base line are located the observing stations. These two stations form a pivot of the corresponding arms, which, of course, when properly set to the azimuth angle, give the corresponding position of the line of sight of the observing instrument. The intersecting point is the position of the target. A semi-circular board, with two arms working on it on different centers, would, of course, be impractical. There has been worked out a very ingenious method of a parallel rule, which will allow both arms to be set on the same circle, this circle, however, carrying two scales, one for the primary arm, and the other for the secondary arm.

The directing point of the battery is also laid out on the plotting board to scale, and centered on this point is what is called the "Gun arm." In finding the range, after the primary and secondary arms have been set for the point corresponding

to the line of sight of the observing instruments, we bring up to the intersection a little square piece of metal called a "targ." The gun arm is then swung around and brought up against the same targ. The gun arm is graduated to read in yards, and the actual range of the target is read directly from the gun arm.

This range, of course, is of no practical use; the only range we can fire on is the corrected range. The correction is obtained on what we call the "range correction board," which is simply a vertical board, with a blueprint mounted on it, with all kinds of curves, a T-square, and a few other things, with which we make corrections for the height of the tide, density of the atmosphere, velocity and direction of the wind, muzzle velocity and travel of the target during time of flight. When this correction is properly worked out, it brings you to a reference number, the normal point of which is 2,000. On the gun arm is a little adjusting screw, with the same reference numbers, and as the man on the range correction board works out his correction, he sets the gun arm for the same reference number, and then the man reading the range, reads not the actual range, but the corrected range, which is the range that is telephoned to the gun.

In a similar way we work out correction for deflection. As you all know, a projectile fired from a rifle will curve in the direction of rotation. In our practice, this is to the right, so that we have to make correction in pointing the gun for deflection. There are three corrections used: for drift, as we call the curve of the projectile; for wind, and the travel of the target during time of flight. This is done by a small mechanical adding machine, which, as in the case of the range correction, gives us a reference number. This is in the form of a hypothetical number, the scale being from 0 to 6, with 3 as a neutral point.

In all artillery work, we try to get away from any plus and minus readings, the neutral point being so arranged that the reading is always plus. On the telescope sight at the gun, there is the same scale as the reference number on the deflection correction board, with 3 in the center, 0 on the right and 6 on

the left. When the deflection is sent to the gun pointer, he sets the cross hair of his instrument at the reference number given him. For instance, if the deflection is sent down as 2.85, he moves the cross hair of his instrument until it sets not on 3, but on 2.85. This offsets the line of sight of the instrument with the bore of the gun, so that if he is sighting on a target, the gun is pointed away from the target in the amount of the proper correction for deflection.

This is at best inaccurate, the whole procedure reminding one a great deal of the story of the old professor, who told the boys in the engineering class to "figure out a problem one way, and then a second way to check yourself, and then throw away your results and do what you think best." This is about what we do in artillery work. We get our range and deflection the best we can, and then we fire a trial shot to find out whether we are right, and if not, how much correction we have got to make.

In regard to the range, all corrections but one are fairly accurate, and that one, of course, is the most important of all—the muzzle velocity. It is almost impossible to predict what muzzle velocity will be obtained. We use the greatest precaution in the handling of powder. Every lot as made is stamped with the manufacturer's name and lot number, and every charge that is fired from this lot is carefully recorded, the muzzle velocities being kept and distributed to wherever that powder is used. When we are ready to fire the guns, the procedure is somewhat as follows:

We will say that at a given battery, they are going to fire ten record shots and two trial shots, or twelve rounds. Twelve charges of powder are taken from the magazine. These charges are all made up in individual boxes, very carefully weighed and sealed up in air-tight tin cans, by the ordnance department. These 12 loads of powder are opened up, and the whole amount put in one pile. The powder is then very thoroughly mixed by shoveling over in the same manner that a batch of concrete would be mixed. What is desired by this process is to get an absolutely uniform mixture. We do not care so much what the muzzle velocity is going to be as long as each charge is

exactly the same. After the powder is thoroughly mixed, or as we say "blended," it is rebagged and very carefully weighed, so that each charge may be the same. After the powder is blended, rebagged and resealed in the tin cans, it is ready for use.

One thing that affects the powder more than another is temperature. The temperature at time of firing is, of course, very carefully recorded, and if this temperature varies from the temperature at previous firings, a correction is made. We next look up the results that have been obtained from this lot of powder in previous firings, and estimate as nearly as possible what the muzzle velocity should be. The target is then set out. (We formerly used a target, but do not do that any more, now using a hypothetical target.) In either case, the procedure is the same: The target is fired at after going through all the motions of range and deflection findings, as if it were a moving target. From the results of the trial shot fired at this hypothetical target, we get the arbitrary correction; then if the shot goes over, say 300 yards, the position of the splash is observed very carefully by the observing station, and also by a tug, which is stationed near the target. They take a photograph of the target and splash, and also sight it over an instrument called a "rake," which is very much like a garden rake, made of a board with nails driven into it at uniform intervals. The operator of the rake sights the center nail with the base nail at the end of the handle on the target, and then catches the splash on say, the fifth nail. Knowing the distance of the tug from the target, he can in this way very quickly and accurately locate the distance of the splash from the target. This is signaled back to the battery, and is say, 300 yards over. This information is given to the range correction board operator, and he works his correction backward to get a muzzle velocity, which would reduce his range by 300 yards. The new range correction is then set on the gun arm. This correction is very easily and quickly made, and with the new muzzle velocity set, each succeeding range will have automatically registered the arbitrary correction as developed by the trial shot.

The deflection correction is worked in very much the same manner. This is done by what is termed "jumping the splash." This operation used to be performed by the gun pointer, but now, I believe is done by the observer in the battery commander's station, or by the battery commander himself. When done by the gun pointer, this is a very delicate piece of work, and the procedure is as follows:

When the gun is fired, the gun pointer keeps traversing his gun, keeping the cross hair on the target until he sees the splash, at which instant he stops the gun and moves the cross hair of his instrument on to the splash. This is a very ticklish piece of work, as the man doing it is within 3 or 4 feet of 240 pounds of powder as it goes off, and in addition to this nerve strain, he usually has to sight through a cloud of pretty dense smoke, although we are supposed to have smokeless powder. The time is also very much limited, as for a range of 9,000 yards, the time of flight is in the neighborhood of eight seconds. He therefore has no chance to make a mistake and correct it. However, a good gun pointer will catch his splash nearly every time.

We had one very interesting incident of this in a company I was with. We were firing service charges from a 10" gun. We fired our trial shots, and then, as quite frequently happens, fog came in and one thing and another interfered, and we could not fire our record shots until some hours afterwards. In the meanwhile, of course, something got out of adjustment, and the first shot was pretty bad for deflection, but all right for range. The splash was about 60 yards to the right. We had a very clever little gun pointer. He jumped the splash. At that time we were using material targets, which were 60 feet long and 30 feet high, with a pyramid, whose point was at the center, marking the bull's eye. As I said, he jumped the splash and the second shot, so far as I remember, was fired 58 seconds after the first, and it just took the top off the triangle, showing how cleverly a man can do this gun pointing, if he is really on the job. The first shot was bad, and the gun pointer knowing his business and catching the splash, was able to put the second shot squarely in the bull's eye.

Our friend, the Major here, says that the observing stations are a good deal like the prize fighter's eye—the first thing that is going to be hit and put out of business. I should like to have all you gentlemen, on your next trip to New York by boat, get all the information you can regarding the fortifications protecting New York Harbor, and then when the boat is coming into the Bay, see how many observing stations, or guns, you can locate. I venture to say that all of you who try this experiment will agree with me that the observing stations are not very nearly as much in evidence as the prize fighter's eye, and I believe four out of five of you will get to Broadway without seeing a single observing station, although there are several hundreds of them there. Take it as Fort Wadsworth, on Staten Island, there are a whole row of them that project above the natural hill about 18". There is grass up to them, and grass over the top, and there is about a 6-inch slot that we look through. Now, anybody six or seven miles out to sea can see a big grass hill, but they have got to do some pretty good looking and some pretty good shooting to hit one of those observing stations other than by a chance shot, and then they have got to put four of them out of commission for each battery before we are seriously crippled. If the primary station is put out of commission we can immediately shift over to the battery commander's instrument and the secondary station, or we have the emergency station, which is an instrument set up on a tripod, which operates as a vertical base instrument. In addition, the battery commander's instrument and both the primary and secondary observing instruments can be used as vertical base instruments. Further, the plotting board and observing instrument of the fire commander's plotting room can be used to give ranges for any gun under his command.

It would therefore be, I believe, practically impossible for boats to put the range finding apparatus out of business. If this were the case, however, then we can put it up to the man at the gun, and do pretty good shooting at that.

I believe we are pretty safe from the coast artillery standpoint, if we will not let the "Watchful Waiting" policy go too far. Our guns are not up-to-date; our range finding equip-

ment is not as good as it should be; our ammunition is in horrible shape as far as quantity is concerned; our mine supplies are very limited; our organization for handling the mines is practically nil; our personnel for handling the coast artillery is about one-fifth of what it should be, including the Regulars and the National Guard, but we are exceptionally well situated and it would be almost impossible to conceive of any condition which would make us man all our batteries at one time. But I think, as I said at the start, that the results obtained at the Dardanelles have proved almost beyond dispute that any harbor that is fortified like New York, Boston, Philadelphia or Portland is practically impregnable to boat attack, provided we have the personnel to man these fortifications, which I am sorry to say is not the case at the present time.

PROFESSOR GREGORY: Mr. President, the question of military engineering seems to be very closely related to naval engineering, and I notice we have with us a graduate of the United States Naval Academy, Mr. Manley, and I am sure we would like to hear from him.

MR. MANLEY: The question of gun pointing and the great detail that has to be gone through in the artillery has impressed itself on me as being very different from the conditions which prevail in the naval service. You have, in the naval service, a moving platform, moving on account of the speed of the ship, rolling and pitching; you have no 2,000-foot base line on which you can base your triangulation, nor have you any of the similar conditions that prevail with a fixed battery on land, with a fixed station and accurately measured base line.

The conditions under which the North Sea battle, as I understand, was fought, the firing began at about 20,000 yards, and a great number of hits were made, and both the target and the gun platform were moving at about 30 knots an hour, and still the hits were made and they didn't have any time for preliminary calculations.

Now, the system of training of gun pointers in the navy has been—I am not familiar with it in the past few years, although I understand that it is practically the same—it has been to have continual practice under conditions which as nearly ap-

proximate the rolling of a ship under way as can be. A small rifle is clamped alongside of a large gun, and the boom is rigged up, and at the foot of this boom is a sandbox and on this sandbox is placed a target which bears the same relation to the regular sized target as the length of that boom bears to the distance of the regular target. That boom has a top lift and guide which enables it to be raised and lowered and worked back and forth at the same time, in order to as nearly as possible simulate the motion of a rolling ship. The gun is trained in azimuth by the gun pointer, and by a second gun pointer it is lifted and depressed. They have also a third man who is trained as a gun pointer, who is usually called a sight-setter. He gets his distances by telephone or other means of communication from the central fire control station, and these men, in practice of any kind—and in battle the same way—are obliged to keep the cross hairs of their telescopic sights, which are made double and provided with rubber buffers so that they really are the same as field glasses, and the cross hairs are very easily distinguished and can be placed on any part of the ship that he wants to hit—they are required to keep these cross wires on the target at all times, no matter how much he ship rolls and pitches or moves to and fro. Now, if the ship is rising and this gun is going up or being depressed, so that at all times it has a motion, at any time the projectile is fired it will hit. If the cross wires happen to be on that ship when the gun is fired it will not hit, but by continuous aim, the projectile in leaving the gun is given a motion which will put it right to the mark. Now, I want to make that clear. If you are shooting at a duck and you shoot just at one particular time, aiming at the duck, your shot will go behind him, but if follow the duck around, so that your gun is moving at the same rate he is moving, when the shot leaves the end of your gun it has not only the force and direction which the powder gives it, but it has the direction of the motion which you give the gun. That has been worked out perfectly, and the continuous aim has changed the navy's hits from 3 per cent, at the time of Santiago, to a very much higher per cent.

They also have spotters, and these men become very expert in spotting the exact fall of the shot. As a matter of fact, you can stand back of a gun with a caliber as low as 3-inch and see the projectile as it leaves the gun, if you stand directly back of it. A 12-inch shell looks like a baseball going through the air, and you can follow that until it strikes, and these observers follow this and give to the fire control officer the exact fall of the projectile.

The naval service, of course, is called upon to do most anything in the line of engineering, the same as the engineers. Landing parties construct bridges; they are not specially trained for that, but they have to do whatever they are told to do as the occasion arises.

That is the only comment that I care to make on the discussion.

MR. SHAW: Mr. Chairman, I want to take exception to one point that was raised in the paper, that it takes any great length of time to raise that arm of the service from volunteers.

I had the pleasure of belonging to that arm at one time, and we raised a regiment of engineers in about twelve days. It is true that it might have been criticised somewhat as to its efficiency and ability to work under extreme conditions. There were some examples that occurred shortly after we were put into service which showed that there were some weaknesses in the service. For instance, when the company to which I belonged was sworn in by a regular army officer, after swearing them in he turned around to the captain, who was present, and suggested that he put them in company formation and take them down to the train to go to the station where we were to be put in camp for training. The captain turned to the second lieutenant, the first lieutenant not being present, and told him to put them in company formation; the second lieutenant declined and picked on a sergeant—there were five sergeants present and four or five corporals—and it finally devolved upon a private as being the only one present who knew enough about military matters to put them into company formation and take charge of the company for three days, until the proper man came along. Of course, as I say, they were raised in ten days.

There is another illustration: We had a mighty good bunch of men there, who proved very capable after they got in a position where they could work, but the first piece of work which I was called upon to do was at Montauk Point, in laying out some drainage for the roads there for the camp. We really needed some instruments; a transit would have been an advantage, and a level was almost a necessity for taking care of the water. On investigation, it was found that the transit was out of commission because one of the volunteer engineer officers had tried to use it and the levelling screws were not long enough to level it up, and he tried to force it level and they stuck and it couldn't be used. That transit wasn't used until after the war. The level was gotten out then, and it was found that the bubble tube had been broken by dropping the level into the box by one of the volunteer commissioned officers,—so that that whole drainage job was done by measuring up the surface of the water and catching levels in that way, in spite of the fact that the regiment was raised in ten days.

But I must say that I believe that the material which we have in this country will lend itself to the rapid accumulation of an engineer corps, provided it can be properly officered by experienced men. I think with our large railroad jobs and construction jobs that we can get these men skilled in the various lines which are needed in a minimum length of time. They need the military training, it is true, but I believe that they can get it very shortly. But I do think that the greatest, and almost an absolute need, is to get men who are efficient to train them. We cannot possibly expect, with our present organization, to develop men enough to officer even the minor positions of the engineer corps which would be needed in a great war, from the nucleus which is formed by the present engineer corps of the army, and I think that is a point which the Government has to give attention to perhaps more than any other one point of the service, that is, to see that men are given that training who will perhaps not be able to go into the field as fully equipped officers of the engineering corps, but who will at least have the rudimentary training to take those men out.

I don't think in our case that below the rank of the Lieutenant-Colonel, who was a regular army man, we had a single man who was even remotely eligible to the position to command an engineer squad, and the entire regiment was of no avail whatever until after months of use. Of course, we did not get into actual service at all—I guess none of the volunteer regiments of engineers got into actual service except those that went to Porto Rico—but there was a great deal of work done which could have been done better and in one-fourth of the time by trained men, and at a fraction of the cost.

We had the raw material; we had men in our particular company who were capable of doing almost any kind of work that they were called upon to do. At Montauk Point, the Westinghouse Company made us a present of a complete electric light outfit. Our company put that up and installed it in every way, and it worked perfectly. We put up a telephone system and a water treating plant, and it was all done by men taken right out of the ranks, who were expert in those particular lines, but not properly officered. I say if we had had proper officers for handling these men, the work could have been done with far greater efficiency.

**DISCUSSION UPON "A SPILLWAY INTO LAKE
BORGNE (Continued).**

(Meeting held October 11, 1915)

THE PRESIDENT: We have to-night a continued discussion on Mr. Kemper's paper on the subject of a spillway at Lake Borgne Canal, and in connection with that, the journal appeared this morning with the publication of Mr. Kemper's paper and the discussion we had at the June meeting on this paper, and also with some written discussions by other members, who sent theirs in since that meeting. I think we can begin by having some one open the discussion. I will call on Professor Gregory to open the discussion.

PROFESSOR GREGORY: Mr. President, it is only a few months ago that we had a very interesting paper by Major Kerr on the levees of Louisiana. In the discussion of that paper, something was said about spillways. That was an innocent question, but it started something, and I think we have reason to be thankful that it did. It was not my privilege to hear this paper when it was read before the society, but in the last two or three days I have read the paper, and I have read the discussion that is printed in our journal. It seems to me that the discussion has been very complete, very thorough; that it covers the ground sufficiently. When the paper was first spoken of, I had some wild ideas of joining in the discussion, myself. However, I find, after reading over the discussion, that everything has been said that needs to be said, and that it is just as well that I did not avail myself of the privilege of discussing it.

For many years past, and especially during high water, the question of spillways for the Mississippi has appeared, and we engineers of course, have known where we could find things about spillways, but the material has been widely scattered, and many of us have been too busy to gather that material together and to have it available when it is most needed. I think in this paper and in the discussion that has followed, the material has been brought together, and I think the society is to be congratulated on having this material in such good form.

THE PRESIDENT: We have to-night, I notice in this journal, a letter from Mr. Ockerson, of the Mississippi River Commission, addressed to Mr. Anderson. I would be glad to have Mr. Anderson read that letter.

MR. ANDERSON: I had hoped that the journal would reach all the members by this morning, at least, because it was mailed on Saturday morning. This letter was received by me from Mr. Ockerson during the summer, and you will notice in the close of the letter that he makes the point that he has not entered into the technical discussion of the subject. I wrote to him immediately and told him we would be delighted if he would take up the discussion of the technical side, but for some reason he preferred not to do it. This letter is dated August 9, 1915. (*See Proceedings, Vol. I, No. 5, pp. 272-274.*)

THE PRESIDENT: The letter just read was in response to the sending of copies of Mr. Kemper's paper to the president of the Mississippi River Commission, with the request that they be distributed to the members of the Commission and an invitation included to have them discuss the paper.

We have with us to-night Mr. Klorer, who sent in a discussion on this paper, and I would be glad to hear from him.

PROFESSOR GREGORY: Mr. President, I think very few of us have read this paper, and those of us who have would enjoy hearing Mr. Klorer present his own case.

MR. KLOLER: Mr. President and Gentlemen: This is very much like having the left-over supper for breakfast in the morning, breaking in in this manner.

(Mr. Klorer here read the discussion from the journal, illustrating by means of a diagram displayed on the blackboard).

THE PRESIDENT: We have with us to-night a representative from the Government Engineer's office, Mr. Knobloch. We will be glad to hear from him.

MR. KNOBLOCH: I have nothing to say, thank you.

THE PRESIDENT: We also have with us Col. Lewis.

COL. LEWIS: Mr. President, I received a note from Mr. Shaw, Chairman of the Publication Committee, about sending in a written discussion on this paper. I didn't know that this journal had been published, and I had prepared a written dis-

cussion and I was afraid I wouldn't have it ready to-night, and I answered Mr. Shaw's communication, stating that if I were not to be present to-night, I would discuss it later. But I see that partly it has already been published. Now, that which appears in the journal is an oral discussion that took place on the occasion of that meeting, and I would have liked very much to have supplemented that oral discussion that night with the paper that I have prepared. I hardly see that I can very well put that in, because the discussion has already been published. However, I will probably submit this and let it go for what it is worth.

THE PRESIDENT: We will be glad to have you read it, Col. Lewis.

COL. LEWIS: It embodies a portion of that oral discussion. Whether due to the fault of the stenographer, or because of the shape of the oral discussions, themselves, from the form in which they were transmitted to me I couldn't make much of them, so I had written out what I had said that night. I am sorry it appears in the publication, because I intended to write a paper and go into the subject somewhat more in detail. I happened to finish this—I concluded I would try to finish it, and I finished it last night. I would like to read it, with your permission.

This paper, as its heading states, first involves the advocating of a spillway into Lake Borgne, to be located at a distance of some ten miles below Canal street on the Mississippi river, and followed by a corollary, an increased outlet through the Atchafalaya, as a means of Flood Relief in Louisiana.

In presenting this paper, the writer insinuates strongly of the sincerity of Engineers who differ with him in the treatment of the Mississippi and Atchafalaya rivers. It is unfortunate that the writer should entertain any such opinion of his conferees, who are members of the society. The society is organized to uplift the membership, as well as to enlighten them on whatever subjects of Engineering are brought before it, which can be best accomplished by discussions, without insinuation or innuendo.

The allotment of \$1,000,000 by the United States Government towards the rebuilding of levees proved an incentive and encouragement to the dwellers of the Mississippi Valley, and resulted in the formation of Levee Districts with extraordinary powers of taxation, etc., and from this time on until, to date, the Mississippi River Commission has undertaken in coöperation with the different Levee Boards throughout the Valley, the task of strengthening the existing lines of levees, the construction of new levees, the prevention of erosion of river bank in the prominent bends, and harbors, and the dredging of bars on crossings at the foot of the bends in the upper portion of the Lower Mississippi.

The history of the experience with construction works is so similar to that with revetment, that it need not be given at length. The character of the work evolved, and found necessary is more substantial, and therefore more costly, than was at first anticipated. The sub-aqueous mattress alone is placed in position at a cost of \$30.00 per lineal foot, or \$150,000 per mile; and whilst a great deal of this work has been done, and accomplished its purpose, the extension as a system, over the entire river, will depend on future appropriations at the disposal of the Commission. The attention of the Commission was directed some twenty years ago to the progress made in the art of hydraulic dredging, and to the study of its application to the low water navigation problem of the Mississippi River.

In the year 1894, an experimental dredge was designed, built and operated with such promise of success that the original project of improvement was amended to include the dredging of bars which obstructed low water navigation, so as to secure a navigable channel, at the lowest stages, with a depth of nine feet and a width of two hundred and fifty feet. The success of this experiment led the Commission from this time on to the construction of nine more dredges, with all the improvements which experience has proved valuable, which are annually in commission during low water period. These immense dredges are capable of making a cut from four to six feet deep, and from forty to sixty feet wide, with a rate of progress of from one hundred to one hundred and fifty feet per hour, or half a mile

per day. They handle from 2,000 to 4,000 cubic yards per hour, according to the nature of the material. They have maintained a navigable channel throughout their field of operation; that is, below Cairo, of ten feet at all times through all bars developing less than this depth of water, and at a cost not exceeding \$250,000 per annum (not including their first cost).

In the construction of mat building for bank protection work, and bar dredging on the Mississippi River, are found the greatest development and application of these two branches of engineering art that has yet been known. The construction of levees also as a necessary adjunct to the problem of low water navigation in the Lower Mississippi River, as well as a prevention of overflow has met with equal development and success, although it has been a Herculean task to the riparian owners dwelling in the Lower Valley, involving, up to date, an expenditure of some \$42,000,000 by the State of Louisiana; \$27,000,000 by the State of Mississippi, and \$6,500,000 by the State of Arkansas, and it will necessitate the expenditure of some forty or sixty millions more of money to complete, to establish and fixed grades these levees, revet the caving bends and maintain a low water channel of the prescribed depth. By proper maintenance and policing of the levee lines, on some comprehensive system, as is practiced in Holland and Belgium, and by the prevention of caving of river bank relegated to the United States Government, the all "Levees only" policy, as the writer terms it, will be found to the Mississippi River Engineer of the future with their experience and study the prime and necessary factor in the solution of the problem.

The writer seems to lay some stress on the hydraulic axiom that the velocity of flow is in direct proportion to the square root of the slope, and that the carrying capacity of the stream varies as the sixth power of the velocity—so do 2 and 2 make four in arithmetic. Like signs produce plus, unlike signs produce minus in algebra—the square of the hypotenuse of a right angle triangle is equal to the sum of the squares of the other two sides in geometry— $\sin^2 a + \cos^2 a = 1$ in trigonometry—we can continue *ad libitum* along the line—in physics and mechanics

to enumerate well concluded axioms and formulae, which are admitted without argument.

The writer, I gainsay, knows that the elementary principles of Hydraulic Engineering, as applied to sedimentary streams, are being applied daily by the Engineers employed on levees, bank protection work, etc., on the Mississippi River. Probably, he would like to have the chip from the shoulder to be knocked off in an eddy current, so that he could convince the Engineers of a "Levees only" advocate, as he terms them when he states that they had placed the "cart before the horse." This reminds me of a little experience of my own with old Grandpa Spies, a German of Donaldsonville fame during the high water of 1908. Whilst standing on the crown of the levee, at the crest of the flood, with several planters, this old gentleman, now dead, made this very sensible remark: "vat does these river Engineers know anyhow, lookt, see dat chip sailing up-stream, isn't dat enough proof that the Gulf of Mexico is filling up this river." Well, Commodore Maury tells us in his *Physical Geography*, that the Mississippi River, paradoxically runs upstream, for its mouth is farther from the center of the earth than its head. He tells us further, that the concave bends are caused by the centripetal force due to the daily revolutions of the earth's surface; and then we have the book of books, "Humphrey's and Abbott Report on the Mississippi River"—the Bible as it were. This is the book which some Engineers of to-date, frequently quote and misquote. What the young Engineer who desires to make a study of the Mississippi River should do, is to follow the advice of Lord Verulam, read everything that has been written or taken in testimony on this subject, whilst he is engaged practically in this specialty of the profession, but I would not recommend to him to swallow the literature published on the subject, but rather admonish him to discriminate by chewing it carefully, so as to digest the leaven, and discard the chaff.

Let us get to the leaven of the subject. The theory of the hydraulics of sedimentary rivers which condemns outlets appears in all books of authority on the subject since the time of the early Italian engineers, but has not been more clearly and

concisely stated than by General C. B. Comstock, in the report of the Mississippi River Commission for 1890, as follows:

“A sedimentary river flowing in its own alluvion only acquires a stable regimen when it has taken a slope suitable to its varying discharges and to the material through which it flows; and, as a rule, these slopes diminish as the size of the river increases and increase as the size of the river decreases.

“Sedimentary rivers flowing in their own alluvion take larger slopes the smaller they are. Hence, if at Lake Borgne or elsewhere in its delta, the Mississippi were divided into two rivers, since each would be smaller than the present river, the two rivers would go to work to obtain the new and steeper slopes suited to dimensions smaller than those of the original river, and hence would build up their beds. This process would only cease when the steeper slopes needed by each were obtained. Since both rivers would then have one end at the Gulf, and have steeper slopes up to their point of divergence than the river now has, the flood surface of the river at that point would be higher than now.”

“It may be concluded that the reduction, by any large amount, of the flow of the Mississippi at Lake Borgne will be ultimately followed by a rise in the flood heights at that place and a shoaling of the river below and at its mouth.”

“Both theory and experience show that when, at all stages, a reduction in the size of a river flowing in alluvial soil is made, or the river is split in two, the smaller rivers gradually take greater slopes than the main river had. Hence both the main river and the new river would gradually increase their slopes to suit the new conditions. Since the slope begins at the Gulf, it can not become greater on the main river below Lake Borgne, which is not nearly straight, without increasing flood heights at Lake Borgne. After some years, then, if both routes to the sea remained large rivers, the flood level above the outlet would be higher than it is now, unless, as indeed is

not improbable, the large amount of sediment which would be dropped into Lake Borgne (where the flood velocities would at first be but about one-sixth of those in the Mississippi) should close this outlet, thus repairing the injury done to the main river. A large diversion of flow from the Mississippi to Lake Borgne would also diminish the depths at the present mouths of the river."

This statement was made with special reference to the proposed Lake Borgne outlet, but, as indicated in the text, the principle is of general application.

"Outlets are condemned, therefore, because they are opposed to the accepted theory of hydraulics as applied to sedimentary rivers, because their detrimental effect has been established by observations made for the special purpose of determining their results, and because, even if they were innocuous or beneficial to the river, it is safer and cheaper to close them than to undertake the control of their discharge, by weirs and double lines of levees, even in the limited district below Red River, where, alone, the system is physically applicable."

The question of assisting the "levees" by reducing the hydrostatic pressure during extraordinary floods, by reservoirs, spillways or outlets below Red River, has been discussed time and again. The writer seems to dwell on the advantage of a spillway located about ten miles below Canal street, in the neighborhood of Lake Borgne Canal, but admits that he is unable to accurately calculate how wide the spillway should be to accomplish this result. Well, that is the whole meat in the cocoanut—he, nor any other engineer, who has given this subject study and serious thought, has been able to accurately locate spillways, the required number, or to guarantee that the spillway or spillways will not silt up, etc. I believe the spillway idea is somewhat tantamount to the reservoir conception. My conception of a reservoir system, would be to erect on the crown of the levees on both banks of the river, a sufficient number of cisterns or tanks, calculated to relieve the lower river of the required number of cubic feet per second. These cisterns could be filled, and replenished by pumps, which could be operated,

either by utilizing the current in the river on the Ecmuthesis Theory of Prof. Fontaine, or by erecting at certain intervals windmills, "a la Don Quixote," thus utilizing either wind or water power to relieve the Lower Mississippi River of its surplus water at flood times, and by spilling it over the Valley in homeopathic doses, the inhabitants of the Valley could use it for domestic purposes.

To create a spillway or outlet to the Mississippi River in the neighborhood of New Orleans, on the East Bank of the River, be it located at Bonnet Carré, which is but 5 miles across land to Lake Pontchartrain, or 10 miles below the city into Lake Borgne, which is about 5 miles across the land from the river, and nearer the Gulf, or at Kennerville, as suggested and reported by a United States Engineer, or several spillways, as suggested and reported by a United States Engineer. In my opinion, experience and study of the Mississippi River, on the effect of past crevasses, teach us that these spillways will silt up and form land, and in the course of time will practically close themselves. As an illustration of this fact, it is well known that the Jump, a crevasse that took place some sixty or seventy years ago on the west bank of the river some 85 miles below the city of New Orleans, was navigable for vessels drawing 18 feet or more, at its incipency, and was used for many years by them as a short cut to the west in their trade to Galveston, Indianola, Tampico, Vera Cruz, etc. To-day there is no such depth of channel through the Jump, it has silted up and made land to such an extent, that an ordinary gasoline launch or lugger drawing four feet can scarcely get through it; so it is with Cubitt's Gap or crevasse on the East Bank of the river and a few miles above the Head of the Passes, at the upper end of which, where new land has been made by deposit through this crevasse which took place some 40 or 50 years ago, the new Quarantine Station has been built. These breaks have also caused to a certain extent the main river to silt up near the Head of the Passes.

The Bonnet Carré crevasse took place in the flood year of 1874. It was for the time being a great spillway or outlet and relieved the city of New Orleans from threatened overflows. It

ran for eight years and was closed in 1882. In its incipiency it discharged fully one-fourth of the volume of water in the Mississippi River flowing by at that point, when it was closed, the previous deep swamp of five miles to Lake Pontchartrain was silted up, and the channels of the crevasse had gradually refilled. You can drive from the river to Lake Pontchartrain to-day through five miles of the finest land in the State, where previous to 1874 existed an impassable swamp.

As to the writer's increased outlet through the Atchafalaya by digging a canal from Grand Lake at Charenton into Cote Blanche Bay, using Bayou Teche as a channel for four miles of the total distance of thirteen miles, this may be very plausible and feasible as a waterway for navigation purposes, and for that reason some local benefit, but I cannot agree with him that it will relieve conditions in the Lower Atchafalaya any more than a similar canal would relieve conditions in the Lower Mississippi. The proper solution is to cure the evil at the head of the source. This problem is receiving considerable attention at the hands of the members of the Mississippi River Commission, et al., engineers who are giving it thought and study.

I do not consider that the closing of the head and mouth of Old River will have any great raising of the flood levels on the Mississippi River, for I believe that the regimen of the river from Red River Landing down will adjust itself in time to take care of all surplus flood waters that are now discharged through the Atchafalaya outlet. If ever it should develop by surveys, etc., that there is a growing tendency of the Mississippi River taking the shortest route to the Gulf of Mexico by the Atchafalaya—then, I believe, the prejudice of the closure of Old River will be done away with. Divorcing the Mississippi and Atchafalaya River will relieve conditions in the Lower Atchafalaya. It will not be necessary to build such large levees, the Atchafalaya divorced will easily accommodate the floods of the Red River Valley, and the drainage of the Tensas Basin.

MR. COLEMAN: Mr. Chairman, I have not given very much further thought to the matter, or with any idea of putting into words such additional thoughts as I have, beyond those which I expressed on the occasion when the paper was read. This

question has been a sort of burning question of the hour among the members of the profession ever since I have had the honor of being a member of the profession, and, of course, I have given a great deal of thought and study to it, as all other engineers have, and the conclusions that I had reached, and still maintain, which constitute of me an advocate of the all levee system, are so absolutely convincing and satisfying to my own mind and intelligence that it has never seemed to me—well, I have never been able to quite grasp the idea that any other student of the question, who had gotten all the information in his possession that I have gotten into mine, could have reached any other conclusion. Now, I say that without any reflection at all on Mr. Kemper, because, as I stated at the last meeting, I have the most absolute conviction in my own mind that Mr. Kemper is just as sincere in his views as I am in my views, and then, besides, I have had experiences in the recent past, to say nothing of the more distant past, where differences of opinion do exist between engineers on given subjects where each of them is perfectly sincere, and in the experiences that I have in mind at the moment, where my own sincerity was brought into question, so I have a fellow feeling for the man who occupies a minority position on any question that is under discussion, and I am especially well qualified to accord to him the belief that his convictions are sincere.

Turning back to the subject, outlets versus levees, the instances which I cited at the last meeting of the constant deterioration of the channel of the Mississippi River below the outlet point for the Atchafalaya, or say at Red River Landing, have always been to my mind one of the most convincing arguments in favor of the all levees or confinement theory and against the outlet theory. And when it is taken into consideration that that is not an isolated case, and that on every crevasse that has ever taken place where measurements have actually been made on the river, similar conditions have immediately been brought about by the presence of the crevasse—deterioration of the channel of the main stream below the crevasse—it seems to me that the fact, whether it might be explainable by any mathematical formulæ or not, is incontrovertible; if the laws which we

know and which we cite do not make allowance for that fact, then we are ignorant of some laws of nature, because, of course, nature works by law always, for the reason that these shoalings of the main stream, these deteriorations of the main stream below outlets and crevasses, have always taken place in every single instance. Now, if that is true of every outlet that has ever occurred on the river, whether it be a crevasse or the other kind of outlet, it certainly seems beyond question that it will occur for every future outlet that may be created, whether it be a crevasse or whether it be an artificially constructed outlet. And that being the case, if the main stream is going to depreciate or deteriorate, and if it should deteriorate to the extent which would be compensated for by the outlet, it does not seem to me that any result that would in any way approximate the result desired by the outlet theorists could be accomplished by the creation of these outlets.

I think Mr. Klorer's diagram, which shows the gauge relations at Donaldsonville and at College Point with the Baton Rouge Gauge before and since the closure of the Bayou Lafourche as an outlet, is very illuminating, and while it is in no degree surprising to me—it is such a result as I expected to find on the plotting up of such curves—I am particularly glad that he has taken the trouble to plot these curves, to illustrate the actual results as shown at that point.

THE PRESIDENT: We have with us to-night Mr. Barton, of the United States Engineer's office.

MR. BARTON: I have nothing to say on the subject.

THE PRESIDENT: Mr. Hutson, have you anything?

MR. HUTSON: I have had a talk with Mr. Shaw about some things that he calls "laboratory experiments," but I was just playing in sand like any other kid during my vacation over there on the coast. Perhaps some of you have noticed that the beach there is made up of sand composed of some black grains and some white grains. It seems, I suppose, this organic matter has stained some of the sand. Anyhow, after a rain there would be a stream of water down the beach and it would be eroding the beach on the upper part and forming a delta lower down. Well, due to the grains of sand being colored that way, you

could, in these little rivulets, watch every grain of sand, practically, where it come from and where it went. At least, you couldn't watch each individual grain, but there seemed to be a difference in specific gravity in these grains of sand, so it would lay the black grains all together and lay the white grains all together, forming practically a moving picture of the movement of these sands. Well, I was interested in watching that, as a very nice Delta was forming there, and having this paper in mind, I dug a little outlet. The stream did just what most engineers predict—it began right away to silt up the main stream and wash a big channel down the outlet, but it pretty soon got tired of that, and silted up the outlet and overflowed and went on with what it had been doing before, building a nice, uniform delta, shaped about like a sector of possibly 90 degrees, with about the same slope in every direction. Well, I told that to Mr. Shaw, and he evidently sprung this to get me into an argument in favor of the levees, but where he made his mistake, I did not finish telling him what I did. After doing that, I built a nice leveed stream all the way down. Of course, the sand was wet, practically quicksand, and what the little stream did was to wash that levee away, so that although it was a fine place to study the effect of the stream, you can't say that I proved anything, except to learn what I have decided a number of times—that I don't know anything about rivers.

But there was one thing that I did learn there; that is, I have always wondered—I have always had a theory that this sinuous course that the river takes must be a wave motion, that is, it is like you take a rope and shake it this way—it forms waves. Well, I have always wondered whether this river had somebody shaking it up at the head end or down at the tail end; in other words, whether this caving of the bank, caving in one place and filling in another, whether that is a progressive movement downstream or progressive movement upstream, or just what it was, and the reason I have been interested is because if you select a site for a pumping plant, it is always a question as to whether to put it on a caving bank or filling bank, because it is always a question of one or the other, and if you put it where you think it is going to do either, it always does the opposite.

So a long time ago, on another vacation—when I was quarantined, in fact—I built a little artificial channel, and in order to have something that the stream would move very readily, I took the only thing I had available—I sifted some wood ashes, and I thought that that would move easily if I put it in a box and gave it a grade and put a hose at the upper end, and I thought: “Now, I will put a perfectly straight channel here and let the water flow down the channel, and I will square this thing off with strings and every day I will sketch this stream and learn whether this is a progressive movement downstream or not.” That was my theory, that it would progress downstream. Well, I put the hose there at night and went out next morning, and with these wood ashes, which were wet, and I had shaken it down, I expected to find a nice sinuous stream next morning. Instead of that, instead of the silt-carrying stream, I found something like the Niagara River. In other words, I had given this thing considerable slope and this water had washed back a sort of cataract, and below that rapids, with a whirlpool, and very much the characteristics of the Niagara River. Now, at that time, I decided that the clear water did not tend to make the stream change its channel; and the reason I decided it—I took a stick and stirred it up at the headwaters, and as soon as I did that, I got the Mississippi River effect—changing current and crevasses and delta and all of that, and as soon as I let it run clear, I got none of that effect. Well, since then I have decided that maybe my wood ashes set during the night and I had a crust there that was more like Niagara than like a silt-bearing stream; so over there on the coast, with this sand, I decided that it was more the conditions of a silt-bearing stream. But I never did come to any decided conclusion except that I don’t know anything about rivers. But it is an ideal place to study that sort of thing, and with those sands of two colors, I think it might be a good place to do some real experimental study, and I have never found anybody yet that can tell me whether a caving bank is progressive upstream or downstream, or what it is going to be. You can see that movement over there very easily, and that is progressive downstream. There will be these ripples in the water forming little sand

waves that are continually moving downstream, and it would seem that the caving bank may be progressive downstream too, but I couldn't see anything of that. It seems that if it is a wave motion, some engineer ought to invent a Maxim silencer to put on the river and sort of break up the wave motions and make them harmless.

MR. SHAW: The only thing I have to add to what has been said is to call the attention of I suppose most of the older members of the Society, with whom I number myself, who were brought up in their college course on LeConte's Geology—I don't know whether in the later days that is an accepted text or not, but I recall clearly that in his description of rivers and their action, he refers to the Mississippi River, the upper portion of it, as being a "juvenile" river, and the lower portion, that portion below Keokuk or some point below Cairo, as a river in its senility, a river in its senility being a river which has no tendency either to scour or to deposit in total, that is, the mean length of the river will remain the same—the mean fall will remain the same. And I think that has been well illustrated in a number of remarks that have been made to-night, and was brought out in the paper which Major Starring wrote a number of years ago, and which was published in the *Engineering News*, in which he called attention to the fact that the actual total length of the river had not varied from the time the first measurements were made, in 1825, up to the time that his data were prepared, a comparatively few years ago. I think that would answer, perhaps, Mr. Hutson's question as to the tendency of the movement of these bends of the river. I very much doubt if there is any tendency of the bends to work downstream or upstream, their action being purely local. The first tendency of a stream which might have been an artificially straightened channel is that it will, by means of eddies that are caused by slight obstructions, start scouring on one side or the other, and as that scouring increases, a bend is created, until the river is so great that it cuts that bend off, the shortness of the river being compensated by the straightening at other points.

If we accept the theory of LeConte that the Mississippi River is in its senility, then we must accept the fact that any artificial

change in its channel will affect it in the shape of a readjustment, so that as soon as it is rejuvenated by a short cut, it is bound to readjust the remaining channel until it gets to the actual channel demanded by the mean flow of the river, varying, of course, by a certain amount due to excessive floods, but the mean channel will, of necessity be practically as it is now, and that any radical change will bring about a change which cannot be controlled—it is impossible to conceive the works of man which could control the material which is carried by the river, that is, to prevent the deposit or to prevent the scouring. The only thing which can be done would be to guide and direct, and protect certain local points, but to carry on any works which will dispose of the tremendous amount of silt carried and pushed by the river, it does not seem, from the practical illustrations which we have had, that man can possibly attempt to control that. The amounts, as stated by every student of the Mississippi River, the amounts of silt, are stupendous, and if we are going to affect the velocity to such an extent that any considerable proportion of those amounts will be precipitated, we have brought about a new condition, just as has been illustrated as having occurred at the various crevasses, and it does not look as if we will be able to maintain our river in a desirable condition after these outlets have been provided.

THE PRESIDENT: Is there any one else who would like to discuss Mr. Kemper's paper? Mr. Kemper, I would be glad to hear from you. I thought perhaps after Mr. Hutson got up and gave us his laboratory experiments, you hadn't anything to dispute about it, but after he said your levees were gone, there was some hope for you, I guess.

MR. KEMPER: Why, Mr. President, I am no extemporaneous speaker, you know, and furthermore, these questions are ponderous, and I surely could not attempt offhand here to-night to answer them. My copy of the journal did not come and I haven't known anything of what anyone has said except what I have heard here to-night, and surely these papers would require much more thought than I could give offhand, in fact, some study, before I could attempt to answer them, and in fact, I won't attempt to, to-night. I want to, though.

MR. COLEMAN: I think this is a privilege you surely have, Mr. Kemper, of closing the debate with a written paper.

MR. KEMPER: I surely couldn't do justice to anything here to-night.

THE PRESIDENT: I can assure you you will get every opportunity to answer.

MR. KEMPER: I simply ask that I be given an opportunity at some future time, if it is just by preparing a paper and reading it, if it is the will of this society, or having it published in the journal. I stated in the beginning that I am just in search of light, and that is all I want, and if these arguments are convincing, I will be the quickest man in the world to admit them.

MR. SHAW: Mr. Chairman, I want to explain that I explained to Mr. Kemper that this meeting would be given over to a discussion of the paper and asked him to be present, though I assumed at the time that he would prefer to have time to think over the closure which he would probably wish to give, and he suggested just as he did. Now, as a member of the Publication Committee, and I think I have the sanction of the rest, I want to assure him that we will be very glad to have a contribution from him, to which he can give much more mature thought than he could possibly do to-night.

THE PRESIDENT: I am sure that is the thought of everyone connected with the Publication Committee and also with the journal. If there is no further discussion on that, I think we will close the matter for the time. It may be of some little interest to have Mr. Knobloch tell us what happened down the river.

MR. KNOBLOCH: Well, the papers have mentioned everything that happened down there, I guess.

MR. KEMPER: I would like to ask Mr. Klorer one question. Mr. Klorer, when you found that Bayou Lafourche was discharging 35,000 cubic feet per second, were not the crevasses in operation down the bayou a short distance? That, you know, would affect it very materially. Most any quantity of water can flow through when there is a crevasse near at hand.

MR. KLOLER: Well, it was the recorded discharge through there, and I don't know if the crevasses—probably—the

year was in the 90's, and possibly there may have been some crevasses down there. The stage, as I stated, was 7 or 8 feet lower than the Donaldsonville gague reading at the time Bayou Lafourche was closed, so that 35,000 or 40,000 was not such an awful error or misstatement to make.

MR. KEMPER: Well, you know, I didn't question that positively, because, as I told you, I was not posted, but it was more than I had expected.

MR. KEMPER (by letter):

It is unfortunate that, in discussing the paper read by me before this society, on June 14, 1915, in advocacy of a spillway into Lake Borgne, and an increased outlet through the Atchafalaya River, so much time was consumed, by my various critics, in trying to convey the impression that I was recreant in professional courtesy, because I attacked the system employed by the Mississippi River Commission, and emulated by the various state board of engineers and levee boards throughout the flood plain.

There is no doubt in my mind that it can be conclusively shown that the Mississippi River Commission will brook no opposition to its "Levees only" policy, from those under its control. It may be that if the developments of the discussion of this subject warrants it, I will make this feature the subject of a paper, at some future date. At this time, I will be content with urging upon my hearers and readers the following incontrovertible facts:

The present "Levees only" system is no nearer success than it was forty years ago. The levee districts of Louisiana have been taxed more than forty million dollars, and are continually being taxed more and more, as are also the levee districts of the other states, in the path of the Mississippi, to which must be added the assistance from the general government, amounting to many millions more.

The flood stages have been raised enormously at all points below Cairo, and all provisional grades, established during the past have been exceeded at every gauge, except where crevasses prevented.

The levee foundations are admittedly rotten, attention to which was called, in my previous paper.

The proposed divorcement of the Atchafalaya from the Mississippi, if past experience counts for anything, will raise the flood stage of the Mississippi throughout Louisiana many feet, will cause more floods, more disastrous than formerly, will lead to increased taxation in order to raise more funds to build higher and thicker levees (still on rotten foundations), until, if carried to its ultimate conclusion, will result in abandonment of farms and confiscation of property, for taxes.

This will reduce the available revenues for levees, and terminate in the collapse of the levee system, entirely.

I picture no idle dream. Already, unscientific levying of the Atchafalaya has resulted in the abandonment of more than half of the farming lands that were in cultivation along that river at the time of the flood of 1912.

Because I appreciate the merits of the levees, and, in order that abuse might not lead to the overthrow of the system, entirely, due to top heaviness, I have dared to raise my voice in behalf of the suffering property owners, with whom I share a material interest.

Since, in my opinion, the only remedy, in so far as Louisiana is concerned, lies, is a modification of the present system, it is impossible to advocate the modification, without showing up the faults of the system.

Principles stand higher than men, and individual esteem should never obscure principles.

I hold in high personal esteem every engineer connected with levee work, with whom I am acquainted, but I can not permit this to be an estoppel to my criticism of the present system of river control.

I think I can point to a comparatively recent precedent, within this society, for my professional stand, and, in consequence, have been not a little amused at some of my critics.

Major F. M. Kerr charges me with an obsession, because I am an obscure engineer, and "flock alone" in this discussion. I except to the "obsession" and plead guilty to the other two elements of the charge.

Major Kerr says that my "treatment of the subject is based upon unguarded and untenable assumptions, unsupported in the light of fact, experience and observation, and upon references to statements and expressions of opinion readily controverted by other statements and expressions of opinion of equal, if not stronger force."

The first great flaw that Major Kerr found in my argument was that I could not figure, exactly, how wide the spillway should be to accommodate 358,000 cubic feet of water per second, with a stage of 16 feet at Carrollton.

I do not profess to know it all. The problem is, more or less, unique. It is entirely new (because the Mississippi River Commission will not permit its trial) and involves several modifying variables, whose value can not be accurately calculated, without some experimental precedent.

I, at least, expressed an opinion as to how wide it should be, and whether I guessed too great or too small, the result would be a question only of relative benefit. At least no harm could come from the calculation not being perfect.

By insistent and incorrect comparison of a controlled spillway to a wild crevasse, the Major concludes that no one knows how wide it should be.

I am not disposed to admit as proved all assertions of "Levees only" advocates. No valid reason exists why there should be any question of fact on the subject of river conditions. There should be available data destined to prove, experimentally, all that is necessary for river control.

Never having been directly employed on river work, many experiments and demonstrations have been made with which I am unfamiliar.

Major Kerr has been with the levees forty-four years, and for a great many of these years, his command has been the last word in matters pertaining to levees, in this state. For that reason, I desire to propound a few questions to him, which, if answered conclusively, will effectually dispose of the subject.

The Major quotes a "Universally accepted hydro-dynamic law that in all sedimentary rivers, as the quantity of water is increased, the slopes of the bed and surface are reduced, and

the river current accelerated, the reverse being, of course, also true, as the quantity is diminished the current is retarded, and the bed and surface elevated."

How does the Major reconcile this with Cutter's formula which says that the velocity of flow varies as the square root of the slope? In order to increase the velocity, it is absolutely necessary to increase the slope.

I presume that the answer will be that, ultimately, scouring of the bed will so increase the cross section and reduce the resistance due to friction against the sides and bottom, that it will require a lower stage to create a given volume of flow than formerly.

Taken locally, for the purpose of removing a bar from a given spot in the river, or as applied at the mouth of the river, where velocity is necessary to remove a bar caused by the sudden meeting of the river water with an incoming tide from the gulf, this rule may hold good. Applied, in its entirety, to the Mississippi River it is most disastrous, especially, in the lower reaches, below Red River Landing where the bed does not scour, being of a material (blue clay) almost impervious to the effect of running water.

Let us examine the facts.

We will, I believe, all agree that the elevation of the mouth of the river is practically constant, and that for variations of slope, the elevations of the points above the mouth must be raised and lowered. The advancement of the levee system, the closure of the St. Francis, Tensas and other basins, together with the improved drainage within the basin, have certainly increased the quantity of water within the river during floods. From the Major's "Universally accepted hydro-dynamic law," we would certainly expect all flood stages of the river to be lower than they were before the levees were built.

Cairo is acknowledged to be the key to the flood situation, in the valley. An examination of the flood stages of the river since levee building was inaugurated will show that, for given stages at Cairo, the stages below Cairo are higher than they were before levees were built, and that this increase has been progressive as the levees were extended, and is continuing yet, the

only modification being when stages at certain points are influenced by crevasses.

For instance, in 1862 a stage of 50.76' at Cairo produced a stage of 34.78' at Memphis, a difference of 15.98'.

In 1907, a stage of 50.33' at Cairo produced a stage of 40.30' at Memphis, a difference of 10.03', showing that, in 1907, the gauge at Memphis was 5.95' higher than the same stage at Cairo produced in 1862.

Likewise, in 1912, the increase over what a similar stage at Cairo would have produced prior to the levees, was 8.97 feet, and this with numerous crevasses flowing both above and below Memphis.

According to Major Kerr's address before this society on March 9, last, the Mississippi River Commission have now announced a raise of provisional grade for Memphis of 7.90 feet.

It is a simple matter to raise the provisional grade, this can be done by the commission, at any meeting; to raise the actual grade is far more difficult.

If we compare the Cairo gauge to that at Carrollton, we will see that, in 1862, a stage at Cairo of 50.76' produced a stage at Carrollton of 15.90', a difference of 36.66', while in 1912, a stage at Cairo of 53.95' produced a stage at Carrollton of 21.05', a difference of 32.90', always showing a comparative flood stage below Cairo, higher than was the case before levees were built.

The Atchafalaya river affords an ideal condition for the study of the Major's "Universally accepted hydro-dynamic law."

Practically no water comes into the Atchafalaya except that which enters at its head, at Barbres Landing. There is a gauge, at this point, one at Simmesport, five miles below Barbres Landing, and one at Melville, thirty-one miles below Barbres Landing.

The levee system down the Atchafalaya began in the latter part of the eighties. In 1885, a stage of 41.60 at Barbres Landing produced a stage of 31.65 at Melville, a difference of 9.95'. In 1911, a stage of 40.15' at Barbres Landing produced a stage of 36.68 at Melville, a difference of 3.47'. Showing a comparative rise for Melville, due to the levee system, of 6.48'.

But these are low stages, let us select a high one.

In 1890, Barbres Landing gauge reached 49.70', and Melville gauge reached 35.40', a difference of 14.30'. In 1913, on April 24, when Barbres Landing gauge was 47.40' the Melville gauge registered 41.70 feet, a difference of 5.70'. Upon this day the Atchafalaya levee broke below Melville. Had it held until the Barbres Landing gauge reached 49.70, the Melville gauge would have registered 44.50,' a difference of 5.30', thus showing that for a stage near 50' at Barbres Landing, the stage at Melville is 9' higher than it was before the Atchafalaya was levied.

The "Universally acknowledged hydro-dynamic law" is working badly on the Atchafalaya. In fact, the reverse effect has very nearly depopulated the lower half of that portion which is levied.

Major Kerr ridicules my statement that had all levees held on the Atchafalaya a stage of 52' would have been reached in 1912. He compares it, derisively, to a statement of "a certain railroad magnate of high degree" that the divorcement of the Atchafalaya would increase the New Orleans flood stage by 18'.

Now, I am good natured, and I do not mind being ridiculed, if the other fellow has the goods. I do not, however, think the Major should have been satisfied with giving my statement the horse laugh. He is the highest authority in this State on levee engineering. He surely should have shown by facts and figures wherein I was wrong. I have always claimed that I am only looking for light on the subject.

I figured that the Melville gauge would have reached 52', in 1912, by the following method of simple proportion.

In 1912, on April 10, the day the levee broke below Melville, the Barbres Landing gauge was 44.80' and the Melville gauge was 38.60', a difference of 6.20'.

In 1913, on April 24, the day the levee broke below Melville, the Barbres Landing gauge was 47.40' and the Melville gauge was 41.70', a difference of 5.70'. This makes it clear to my mind that the higher the flood got, the nearer the Melville gauge approached the Barbres Landing gauge. While the Barbres Landing gauge was rising from 44.80' to 47.40' the Melville

gauge was rising from 38.60' to 41.70', which is in proportion of 1.2' to 1'.

Now, in 1912, the Barbres Landing gauge actually reached 54.80', on May 11. The rate of rise of the Melville gauge, under the influence of the various crevasses, got continually less, until, on May 6, it stood still at 41.90', for about 6 days, until the Mississippi began to fall.

The Mississippi River Commission calculate that, had it not been for the Torras and other crevasses (as is evidenced from a letter from Col. Potter to Senator Ransdell, a copy of which is in my possession), the Red River Landing gauge would have reached 1.3' higher than it did. Due to the juxtaposition of the Barbres Landing and Red River Landing gauge, it is certainly reasonable to assume that the Barbres Landing gauge would, also have reached 1.3' higher than it did, which would have brought it to 56.10'. Now, 47.40' from 56.10' leaves 8.70'. If the levees had held it is most reasonable to assume that Melville would have risen 1.2×8.7 , which is 11.44'. Add this to 41.70' and we have 52.14 for the logical flood stage at Melville, for the flood of 1912, had all levees below Red River held.

I contend that this conclusion is entirely reasonable, and call upon Major Kerr to produce the figures upon which he bases his ridicule.

In further reference to the Atchafalaya as an outlet, the Major seems to object to it as such because, during periods of high water in Red River, augmented by crevasses on the Mississippi from Arkansas down, it becomes a material tributary of the Mississippi, thereby notably increasing flood levels at the mouth of Red River and below.

This is my strongest argument against divorcement. As it now exists, Old River is a most excellent equalizer, distributing the burden proportionately between the Atchafalaya and the Mississippi. It would be a mighty injustice to the inhabitants of the Atchafalaya basin to turn loose upon them all of the crevasse water from the mouth of the Arkansas to Donaldsonville, in addition to exposing them to a flood in the Red such as we had in 1908.

As to the 1,300 square miles between the lower Red and the Mississippi, blame for the flooding of which the Major foists upon the Atchafalaya, to attempt to free that from flood at this time by the divorcement plan, would be simply to jeopardize the territory now protected, without benefiting the territory the protection of which is being attempted.

This territory could, however, be materially benefited by lowering flood stages, at Red River Landing, by means of the spillway and increased outlet through the Atchafalaya proposed by me.

Furthermore, the additional burden thrown upon the Mississippi by the divorcement would raise flood stages to a point beyond endurance and the breaking of levees would flood the Concordia basin, undoing all the benefits attained from levying it.

I understand that the Mississippi River Commission have worked out the divorcement problem. Will Major Kerr please figure how the surplus water which went out through the Atchafalaya during the flood of 1912 could be gotten past New Orleans?

The following are the known quantities:

At 21 ft. on the New Orleans gauge, 1,300,000 cu. ft. per sec. flows past. At 53 ft. on Red River Landing gauge, 1,500,000 cu. ft. per sec. flows down the river. The difference of 200,000 cu. ft. per sec. is evidently absorbed by the storage capacity of the river. But at the same time over 300,000 cu. ft. is passing through Old River into the Atchafalaya. Divorce the two rivers and the Mississippi will be obliged to take care of that 300,000 cu. ft.

At New Orleans, it takes about one square foot of cross section to accommodate a flow of 6 cu. ft. per sec., at present. How much additional cross section will it take to accommodate another 300,000 cu. ft? But this brings us right up to that "railroad magnate of high degree" referred to above, who dared say it would be 18'. For fear the Major might charge me with another flight of the imagination, I am not going to attempt to work it myself, but, instead I will assume that the Major would not advocate divorcement unless he had accurately

determined what this rise would be, and what provisions have been made to meet the changed conditions. I am, consequently, going to ask him to furnish us with the result of his calculations.

In reviewing Mr. Waddill's paper, he inspires us with hope but to cast us down, in despair. I surely thought he was going to work out that parabola which he claims would be the resultant of the changed slope of the surface of the water due to the spillway into Lake Borgne.

It is peculiar how contrary water acts towards spillways. It can be following perfectly sound hydrotastic principles, and, at the mention of spillways, it will begin to balk. One might be led to believe that if a spillway were opened into Lake Borgne, the water would flow up it, instead of down it.

I wish Mr. Waddill would produce the formula for the parabola, and show why there would be no increase of flow, at Red River Landing, due to the stage at New Orleans being 16 ft. instead of 21.05 ft. In other words, let us quit asserting, and go to proving, either by correct mathematical deductions or correct demonstrations.

Where does Mr. Waddill get his seeming axiom that "an alluvial stream abhors an outlet?"

Why, an alluvial stream is inconceivable without outlets. It is Nature's own way of disposing of the wear and tear of the earth's surface. All the land below Red River, in Louisiana was formed by outlets; the Sabine, the Calcasieu, the Mermen-tau, the Vermillion, the Teche, all were outlets of Red River, and all performed the functions for which they were intended. They built the country through which they now flow.

I cannot agree with Mr. Waddill that the Atchafalaya was ever the original bed of Red River. On the contrary, the Atchafalaya was the continuation of Bayou Des Glaize, a small local drainage stream.

The Red and the Mississippi joined many thousand years ago when they filled up the estuary into which they both emptied, and, after that time worked together, extending the delta on southward.

Bayou Lafourche was the first outlet on the west, below Red River.

The Atchafalaya basin was ponded off, and, to-day, is thousands of years behind the main mouth of the Mississippi, as a glance at any map of the state will show.

The accident was not what Mr. Waddill claims it was, but it happened when, during a flood, a crevasse on what is now Old River opened up a channel into the Atchafalaya, at Simmesport, and found a short route to the gulf. As we all know, this stream has been growing ever since, and, were it not controlled, would have ere this, probably devastated the basin.

This accident happened probably not more than 200 years ago.

A similar accident was Bayou Plaquemine; it is also of comparatively recent origin.

No outlet bayou ever silts off its head, until it has outlived its usefulness.

When man came here Bayou Lafourche was a deteriorating outlet, that is, it had become almost as long as the Mississippi from the head of the Lafourche to its mouth. The resistance to the water had increased, as the slope decreased, due to its increasing length. Its velocity was accordingly decreasing. No doubt, in time, it would have silted itself off as Bayous Manchac, Paul, Metarie, Terre aux Bœuf and others have done.

All of this conforms to the Chezy or Cutter formula. As the river reaches the dead water of the gulf, it deposits sediment, through which it plows itself a channel, or several channels. Of the several channels, the one which happens to afford the least resistance becomes the major channel; it becomes deeper than the others, which of itself reduces the resistance, this accelerates the velocity, and the major stream utterly dominates the others. As the lesser outlets advance into the gulf, the coefficient of resistance becomes greater, due to the diminished slope; presently, the outlet begins to deteriorate, and, in time, silts off, and becomes innocuous. It is not even valuable as an internal drain, because it is on the ridge formed by itself.

But all of this requires geological epochs, not years. A spillway into Lake Borgne would have a slope five times the

slope in the river. Before it could reach a sufficient length to silt itself up, there could be twenty generations of our descendants all buried.

We are living in the present. We want relief right now. We have thwarted nature by building levees. We must now modify our system by restoring, under control, some of the numerous outlets we have prematurely severed from the river.

The one hydraulic principle which Mr. Waddill advances is that the river is at all times charged with silt to its carrying capacity.

While this is absolutely contrary to all investigation along that line, let us assume it to be true. Then, the total sediment carried would be controlled absolutely by the velocity. Diminish the velocity ever so little, and there would be a deposit. Any change in the cross section of the river will certainly change the velocity. Now, we know that the river is not of uniform cross section. Consequently, it is not of uniform velocity. If Mr. Waddill's contention were correct, every increase of cross section in the river would produce deposit, until the velocity became as great as it was at the point of least cross section, above, and, in a very short time the river would establish and maintain always a perfectly uniform cross section, slope and velocity. This we know to be not the case. Mr. Waddill's position is untenable.

Mr. Klorer's diagram is interesting. I regret that I have not had time to go closely into his deductions. It strikes me, however, that the day to day rise in the river, indicates nothing of importance. The only thing that counts is the comparison of gauges of maximum water. In my figures, I selected years of as nearly equal flood stages before and after closure as possible, and the results show negative. I hope to be able to study this diagram more closely at some date in the near future, as it is refreshing for a "Levees only" man to meet you squarely, with figures, on an issue.

I think Mr. Klorer will have to admit that at any time Bayou Lafourche was taking in 30,000 cu. ft. of water per second, she was dumping it out over the land, quite near the

source. I still think her normal capacity was less than one per cent of that of the Mississippi.

Mr. Klorer is not very successful in his effort to show that the law is all right but that I am wrong because he says I assume that only sediment carried in suspension is to be considered.

On the contrary, I show that a velocity of 5.6 ft. per second, which is my calculated velocity below the spillway, is sufficient to move a stone containing 127 cu. ins. along the bottom of the river. There might be some stones in the river larger than this, in the upper reaches, but I do not think they are encountered in the neighborhood of the proposed spillway, at Lake Borne.

What I do not understand is why do we have to resort to guessing and surmising on this subject? Why does not the State Board of Engineers know these facts? Why do they not produce cross sections and soundings which will show not only the dimensions of the river, but the nature of the materials found? Why do they not conduct a systematical and comprehensive survey of conditions on the Atchafalaya, which is an ideal levee proposition, and endeavor, hereafter, to profit by the developments brought out, and not devote their time to guarding their theories, regardless of the damage done?

If a spillway would, by reducing the velocity, below the spillway, cause a deposit, the reduction of cross section would, in turn, increase the velocity sufficiently to pick up this deposit, and go on with it.

Mr. Klorer's reference to the fact that, during the flood of 1882, there flowed by Red River Landing 1,595,000 cu. ft. per second, which is more than in 1912, does not reckon with the fact that the levees below Red River Landing were practically all down, including the great Morganza levee. When I said that far more water passed Red River Landing, in 1912, than ever before, I meant that it went on down the river to the gulf.

No calculation of river capacity is of any value when influenced by crevasses.

Col. Sidney F. Lewis first calls me an iconoclast, and then likens me to an old German who saw an eddy and thought the gulf was flowing up the river.

The Colonel admits the hydraulic axiom that the velocity of flow is in direct proportion to the square root of the slope, but he seems to resent my applying it.

After some good advice to young engineers (which I wish applied to me) the Colonel quotes, extensively, from Gen. C. B. Comstock, in the report of the Mississippi River Commission for 1890.

Let us examine this paragraph:

“Sedimentary rivers flowing in their own alluvion take larger slopes the smaller they are.”

Of course they do; they have to make up in slope for loss in cross section, and, in order to get the slope, they must swell at the head, because they can not lower the mouth.

“Hence, if at Lake Borgne, or elsewhere, in its delta, the Mississippi were divided into two rivers, since each would be smaller than the present river, the two new rivers would go to work to obtain the new and steeper slopes, suited to dimensions smaller than those of the original river, and hence would build up their beds.”

Let us read this again. I do not understand it very well. It seems to say that if you were to add to the Mississippi river an outlet into Lake Borgne, the river would immediately be smaller than it was before. I do not catch the idea. I admit that the flood stage would be lower, due to the fact that the cross section of the river plus the cross section of the outlet would be greater than the cross section of the river without the outlet, as formerly, but I can not see how it would be smaller. Nor do and, consequently, would not require as great velocity or slope. I see why the two new rivers should go to work to obtain the new and steeper slopes suited to dimensions smaller than the original river. What hydraulic law leads to that deduction? It is not borne out by any known facts. Before man came here the river was as deep as it is, now, and it used its outlets and overflowed its banks every year. The Nile overflows, every year and still it maintains its channel.

“This process would only close when the steeper slopes needed by each were obtained.”

Needed for what, to prove the "Levees only" theory?

The whole quotation from the report is an assertion of a fallacy. It can not be proved, and, unfortunately, the powers in control will not permit it to be disproved.

The deterioration of the lesser outlets of alluvial streams is due to the checking of velocity on account of the diminished slope, caused by the lengthening of the outlet. All of which I have described above.

Furthermore, the Mississippi river is not flowing in a bed of its own alluvion at Lake Borgne. This is universally admitted, and can be shown by examining the material recently excavated at the Frisco slips, at Chalmette.

The Colonel's conception of a reservoir system, while probably intended as ridicule, is about as logical as Gen. Comstock's report on outlets. It accords with the rule of "Levees only" proponents, in discussing any modification of the system. When arguments are wanting, they use ridicule.

That day is gone, or nearly gone.

It will require about one more flood to settle the "Levees only" question, in Louisiana. The turning point was near at hand, during the last flood. When the people realize that Louisiana is half of the flood plain, and can be protected at a cost which is only a fraction of what they now pay, and do not get protection, they will take the situation into their own hands.

If they do not, the levee system will collapse, anyway, for want of money.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Meeting of the Board of Direction, October 11, 1915.

The meeting was called to order with President Datz in the chair. Messrs. Coleman, Gregory, Olsen, Young and Hogg were present.

Minutes of the last meeting were read and approved.

Ballots for the election of new members were opened. There were 47 formal and 3 informal ballots. The following were elected:

Resident Members—Lester F. Alexander, 834 Audubon street, New Orleans; Schuyler P. Coleman, 1446 Nashville avenue, New Orleans; J. L. Dickey, New Orleans; James M. Geary, 707 Title Guarantee Building, New Orleans; Edgar Louis Stream, care Vaccaro Bros., New Orleans.

Nonresident Members—Fred I. Getty, Jennings, La.; A. Rogers Mcilly, 908 Southern Pacific Building, Houston, Tex.

Junior Member—A. M. Fromherz, 1133 Fourth street, New Orleans.

Prof. Gregory moved that the Board of Direction recommend to the Society that on the occasion of the Spring Meeting of the American Society of Mechanical Engineers in this city, that the members of this Society be joint hosts with the local members of the American Society of Mechanical Engineers. The motion was carried.

President Datz stated that time was insufficient to attend to the business before the Board. It was moved and carried that the Board of Direction hold a meeting in the Library Monday, October 18, 1915, at 8 P. M.

The meeting was then adjourned to October 18, 1915.

W. T. HOGG,
Secretary.

Regular Meeting of the Society, October 11, 1915.

The meeting was called to order with President Datz in the chair, and 33 members and guests present.

Minutes of the last meeting were read and approved.

A recommendation from the Board of Direction was read. The Board recommended that on the occasion of the Spring Meeting of the American Society of Mechanical Engineers in this city, that the members of this Society be joint hosts with the local members of the American Society of Mechanical Engineers. Prof. Gregory stated that at a meeting of the local members of the American Society of Mechanical Engineers it was suggested that the Louisiana Engineering Society be joint hosts with them in entertaining. It was further suggested that a joint meeting of the members of the Louisiana Engineering Society

and the local members of the American Society of Mechanical Engineers he held next week. Prof. Gregory moved that the Society accept the recommendation of the Board of Direction. The motion was carried unanimously.

The technical exercises of the evening were then held. They consisted of a general discussion of Mr. J. P. Kemper's paper entitled, "A Paper Advocating a Spillway Into Lake Borgne, Below New Orleans, and An Increased Outlet Through the Atchafalaya, As a Means of Flood Relief in Louisiana." Prof. Gregory lead the discussion. A communication from Mr. Ockerson was read by Prof. Anderson, and Messrs. J. Klorer and S. F. Lewis read their discussions. These papers were followed by further discussions.

There being no further business, the meeting adjourned to the collation.

W. T. HOGG,
Secretary.

Meeting of the Board of Direction, October 18, 1915.

The meeting was called to order with President Datz in the chair, and the entire Board present.

Minutes of the last meeting were read and approved.

The Secretary gave a financial statement showing the expenses and revenues to date and an estimate to December 31, 1915. The revenues are estimated at \$2,187.75, and expenditures \$1,685.15, both to December 31, 1915, which indicate that the operating balance for 1915 will be about \$500.

The question of improving the Library Room was taken up. After some discussion, it was moved and carried that the Library Committee be authorized to spend a portion of their funds for improving the Library room as they may see fit.

The meeting then adjourned.

W. T. HOGG,
Secretary.

Regular Meeting of the Board of Direction, November 8, 1915.

The meeting was called to order with President Datz in the chair and the entire Board present.

Minutes of the last meeting were read and approved.

A communication from Mr. R. H. Baumbach was read. Mr. Baumbach requested that Prof. Anderson be given authority to place a card in the Proceedings informing the membership that he (Mr. Baumbach) was conducting at the establishment of the Dietzgen Company an employment bureau. It was moved and carried that the request be granted.

A communication from the Second Pan-American Scientific Congress

was read. The communication stated that the Executive Committee learns with exceeding pleasure of the acceptance by our Society of the invitation to be represented at the Congress December 27, 1915, to January 8, 1915. It was moved and carried that the communication be received and filed.

Mr. Young, chairman of the Library Committee requested that the Library Committee be given authority to remove certain books from the Library. It was moved and carried that the request be granted.

The following applications were ordered through ballot:

Resident Members—Louis Jacoby, New Orleans; William T. Newton, New Orleans; James Stuart Sharp, New Orleans; Jacques de Tarnowsky, New Orleans; Durald Fuqua Woods, New Orleans.

Nonresident Members—Joseph Prosper Beranger, New York City; Ernest Anderson Rose, Abbeville, La.

Student Members—Edwin F. Emmer, New Orleans; James P. Ewin, New Orleans; Eugene Hawkins, New Orleans; Edward Levi, New Orleans; William Blanc Monroe, New Orleans; Robert Alvin Pierpont, New Orleans; Robert R. Porterfield, New Orleans; Green Rives, New Orleans; Shepard F. Perrin, New Orleans; Horace M. White, New Orleans.

Transfer from Junior to Resident—Arthur A. Diettel, New Orleans.

The following applications were ordered through ballot, subject to the approval of the Membership Committee:

Junior Member—M. A. Beranger.

Transfer Student to Nonresident Junior—B. H. Grehan, Chattanooga

The following bills were approved for payment:

James Buckley & Co., engraving, Proceedings acct.....	\$5.00
M. C. Le Jeune, stenographer, October meeting, Proceedings acct..	10.50
M. C. Le Jeune, stenographer, October meeting, Proceedings acct	10.50
Tulane University Press, October Proceedings acct.....	162.60
Tulane University Press, printing stationery acct.....	72.35
Tulane University Press, printing Library acct.....	1.50
F. N. Norman, collections, miscellaneous acct.....	5.20
Searcy & Pfaff, Ltd., binding 18 Vols., Library acct.....	22.50
A. Daubert, refreshments, Refreshment acct.....	21.00
W. T. Hogg, secretary, salary incidentals, secretary acct.....	44.95

The bills for the Proceedings account were referred to Prof. Anderson for approval.

A bill from Mr. F. Querens for auditing the books was referred to Mr. Datz for investigation.

Mr. Coleman requested that he be given authority to change our account in the Citizens' Bank to another bank. It was moved and carried that the request be granted.

The financial report of the Secretary was read and accepted.

There being no further business, the meeting adjourned.

W. T. HOGG,
Secretary.

Regular Meeting of the Society, November 8, 1915.

The meeting was called to order with President Datz in the chair, and 48 members and guests present.

The minutes of the last meeting were read and approved.

Prof. Gregory stated that he had nothing to report in regard to the arrangements for entertaining the American Society of Mechanical Engineers in the Spring. The Executive Committee had been appointed, and the committee will hold a meeting in the near future.

Mr. Young reported that the Library Committee intends to improve the Library Rooms as soon as Mr. Glenk can arrange to move his office. Mr. Young stated that Mr. Glenk had made special efforts to care for our books during the recent storms, and suggested that the Society extend to Mr. Glenk a vote of thanks. It was moved and carried that Mr. Glenk be extended a rising vote of thanks.

Mr. Marcel Garsaud, Secretary of the State Board of Engineering Examiners, reported that the books of the Board had been audited, and placed a copy of the report with the Secretary for filing.

The receipts and disbursements of the Board are summarized as follows:

Receipts:

1908	\$5.00
1909	30.00
1910	153.00
1911	355.20
1912	109.00
1913	74.00
1914	145.00

Total receipts.....	\$876.20
Deduct total disbursements.....	818.98
Excess in receipts.....	\$57.22

Disbursements:

1908	\$7.65
1909	78.12
1910	.16
1911	255.65
1912	286.50
1913	
1914	190.90

Total	\$818.98
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The technical exercises of the evening consisted of an interesting paper by Mr. F. P. Breckenridge, entitled, "The Operation of the Cotton Warehouses;" an address by Mr. Geo. H. Davis before the League of American Municipalities, entitled, "Economic Advantages Resulting from Port Development," was read by Mr. James M. Robert. Mr. Ernest M. Loeb, president of the Board of Commissioners of the Port of New Orleans, had promised a paper entitled, "The Development of the Port of New Orleans, with special reference to the added facilities now under construction and contemplation," but was unable to appear before the Society.

There being no further business, the meeting adjourned to the collation.

W. T. HOGG,
Secretary.

Special Meeting of the Board of Direction, November 22, 1915.

The meeting was called to order with President Datz in the chair, and Messrs. Coleman, Dusenbury, Gregory, Olsen, Young and Hogg present.

The minutes of the last meeting were read and approved.

Mr. Young requested that the Secretary be ordered to mention in the minutes that the books removed from the library consisted of old Government Documents, and that they were placed in a back room in the Museum, where they will be accessible if wanted.

Ballots for the election of new members were opened. There were 52 formal and 2 informal ballots. The following were elected:

Resident Members—Louis Jacoby, New Orleans; William T. Newton, New Orleans; James S. Sharp, New Orleans; Jacques de Tarnowsky, New Orleans; Durald F. Woods, New Orleans.

Transfer from Junior to Resident Membership—Arthur A. Diettel, New Orleans.

Nonresident Members—Joseph P. Beranger, Santo Domingo; Ernest A. Rose, Abbeville, La.

Student Members—Edwin F. Emmer, New Orleans; James P. Ewin, New Orleans; Eugene C. Hawkins, New Orleans; Edward Levi, New Orleans; William B. Monroe, New Orleans; Robert A. Pierpont, New Orleans; Shepard F. Perrin, New Orleans; Robert R. Porterfield, New Orleans; Green Rives, New Orleans; Horace M. White, New Orleans.

The following applications were ordered through the ballot, subject to the approval of the Membership Committee:

Nonresident Membership—H. A. Mentz, Magnolia, Miss; E. J. Henriquez, Magnolia, Miss.

Resident Membership—Gail H. Browne, New Orleans; Hubbard M. Field, New Orleans; Reginald McC. Schmidt, New Orleans.

It was moved and carried that the membership of the applicants admitted this date be considered to start January 1, 1916.

The resignation of Mr. D. A. Hegarty of Houston, Tex., effective January 1, 1916, was accepted with regret.

A communication from the Second Pan-American Scientific Congress was read. The Society is requested to appoint a delegate and alternate to represent the Society at the Congress. It was moved and carried that the Secretary mail a card to the membership inquiring if any of our members would be in Washington about the time of the Congress (December 27, 1915, January 8, 1916) and could represent the Society at the Congress.

A communication from the Board of Curators of the State Museum was read. The Board stated the conditions under which they would allow the Society to enlarge and improve the library. It was moved by Mr. Dusenbury, seconded by Mr. Coleman, and carried, that the proposition from the Board of Curators be accepted, and that copies of our communications to the Board and the letters from the Board of Curators be spread upon the minutes.

A motion was second and carried to ratify the action of the President in appointing a special committee to audit the books of the Society.

The Secretary suggested some needed changes in our system of bookkeeping and reports. It was moved and carried that the matter be referred to the special auditing committee.

The Secretary was instructed to make a list of the property of the Society and incorporate it in the minutes.

There being no further business, the meeting adjourned.

W. T. HOGG,
Secretary.

RECENT ADDITIONS TO THE LIBRARY.

Steam Boiler Economy, by Wm. Kent.

Valves and Valve Gears, Vol. II; Gasoline, Gas and Oil Engines,
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Properties of Steam and Ammonia, by G. A. Goodenough.

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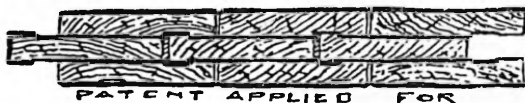
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