

The Proceedings of the Louisiana Engineering Society

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

DOUGLAS ANDERSON, Editor.

The Louisiana Engineering Society is not responsible for any
statement made or opinion expressed in this publication.

Subscription, \$2.00 per annum

Single copy, 35 cents

ADVERTISING RATES

	ONE YEAR	HALF YEAR	ONE ISSUE
Full page.....	\$50.00	\$28.00	\$10.00
Half-page	28.00	15.00	6.00
Quarter-page	15.00	10.00	4.00
One-eighth page.....	10.00	6.00	2.00

For the back outside cover add 50 per cent to the above
rates. For the inside covers add 25 per cent to the above
rates.

Address all communications to
Douglas Anderson, Editor, Tulane University,
New Orleans, La.

LOUISIANA ENGINEERING SOCIETY

OFFICERS FOR 1916

President, SAMUEL YOUNG, 1002 Perrin Building.
Vice-President, A. T. DUSENBURY, 236 Baronne Street.
Secretary, W. T. HOGG, Tulane University.
Treasurer, E. H. COLEMAN, 920 Hibernia Building.

DIRECTORS.

W. B. GREGORY, Tulane University.
OLE K. OLSEN, 822 Perdido Street.
L. C. DATZ, United Gas & Electric Eng. Corporation,
Birmingham, Ala.
R. S. MANLEY, 301 Q. & C. Building.

STANDING COMMITTEES

On Technical Papers

W. B. Gregory
A. M. Lockett
Wm. von Phul

On Library

A. M. Shaw
E. H. Coleman
B. S. Nelson

On Publications—Division "A"

Douglas Anderson
J. M. Robert
W. T. Hogg

On Publications—Division "B"

W. H. Williams
A. T. Dusenbury
R. B. Quincy
John Riess
G. A. Seaver

On Membership—Division "A"

R. S. Manley
James S. Sharp
G. W. Lawes
H. E. Crump
Ole K. Olsen
Chas. M. Kerr
L. H. Guerin

On Membership—Divison "B"

Alfred Raymond
T. L. Willis

On Employment

H. Kokosky
Chas. J. Hardy

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

All business communications should be addressed to W. T. Hogg, Secretary,
P. O. Station 20, New Orleans, La.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. II

FEBRUARY, 1916

No. 1

CONTENTS

FRONTISPICE:

EDITORIAL NOTES AND COMMENT:

PAGE

A Brief Review	1
Our New Officers.....	3
The Proceedings.....	4
The Smoker	6
Operation of the Cotton Warehouses	8
New Members	9
BOOK REVIEWS.....	11
PAPERS AND DISCUSSION:	
Address of the Retiring President. <i>By L. C. Datz</i>	13
Operating Features of the New Orleans Cotton Warehouses. <i>By F. P. Breckenridge</i>	18
Discussion	26
MEMBERSHIP LIST.....	34
ABRIDGED CATALOGUE OF LIBRARY BOOKS	44
MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.....	49

EDITORIAL NOTES AND COMMENT

A Brief Review.—The year 1915 has been one of marked achievement in the history of the *Louisiana Engineering Society*, which reflects great credit upon Mr. L. C. Datz, the retiring President, and his fellow workers upon the official staff and upon the Board of Direction. In his untiring zeal and efficient work for the welfare of the Society Mr. Datz has been an inspiration to his fellow officers and to the membership in general.

Improved methods of book-keeping and accounting have been introduced, and regular monthly reports will be presented showing the financial condition of the Society as a whole as well as the condition of certain special operating funds, such as those of the Library, Proceedings, etc. The present financial condi-

tion is unusually encouraging, the net balance in the general fund being \$354.75 for this year, as compared with \$165.60 for last year.

The Committee on Technical Papers has provided an interesting program for each meeting, and the attendance of members upon these monthly meetings is steadily increasing. A stenographer has been employed for each meeting, and thus a complete record of all discussions has been secured for publication in the *Proceedings*.

There has been a marked increase in the number of new members enrolled during the past year. The total of new enrollments was sixty, and the loss by resignation and otherwise of twenty-four leaves a net increase of thirty-six, thus bringing the total membership up to the figure of two hundred and thirty-six.

The Library Committee, under the efficient leadership of Mr. Samuel Young, has been particularly active, not only in the matter of the acquisition of new books and engineering literature, but also in the line of improving the facilities of the library for purposes of study and reference. The most notable achievement has been the entire remodelling of the room in the Cabildo, which we called by courtesy, our library, but which was really nothing more than a storage room for the books, and a rather inconvenient and uncomfortable one at that. Under the direction of Mr. Frank Churchill, Architect, the room has been completely done over, retaining as far as possible the principal good points of the old design, and rearranging the book shelves and window spaces in such a way as to make it a very much improved library room, and at the same time render it available as an assembly room for our monthly meetings. A pleasing detail in connection with this room will be the collection of portraits of all the past presidents of the *Society*, which Mr. Datz finally succeeded in getting together as the result of a very considerable amount of hard work on his part.

The most ambitious enterprise of Mr. Datz's energetic administration, however, was the launching early in the year 1915 of our own publication, *The Proceedings of the Louisiana Engineering Society*. The success of this undertaking appeared very

doubtful to some of our own members and to a great many of our friends in other societies, but we feel that we may say, that the results of the year just closed have justified Mr. Datz in the faith he felt in the ultimate success of his idea and plan.

And as a fitting climax to the administration of 1915 there came the Engineers' Smoker, a most enjoyable function, participated in by almost a hundred members and their guests, practically double the number in attendance upon any annual dinner of recent years. There was noticeable at this affair a spirit of good feeling among the members and an increased interest in the affairs of the Society which augurs well for its future growth and prosperity.

All in all Mr. Datz has set a high standard for his immediate successor and for those who come after, a standard, however, which we feel safe in predicting, will be measured up to in the administration of our new President, Mr. Samuel Young. He comes into office well prepared for the work, and thoroughly imbued with the feeling that the Louisiana Engineering Society is, and can be made to be to an increasing extent, a strong factor in the uplift and development of the great science and profession of engineering, and a potent influence in the future welfare and prosperity of the State of Louisiana.

This brief statement must not be closed without a word as to the regret which all of us feel in the fact Mr. Datz has been transferred from this city to Birmingham, Alabama. He will be greatly missed in the Society, both for his genial personality and his sterling qualities as a worker, and we bid him God-speed in his new field of labor with the hope that the close proximity of the two cities and the duties of his position will often bring him back into our midst.

Our New Officers.—At the Annual Meeting of the Society, January 8, 1916, the following gentlemen were elected to serve for the ensuing year:

President, Samuel Young.

Vice-President, A. T. Dusenbury.

Secretary, W. T. Hogg.

Treasurer, E. H. Coleman.

Director (for the three-year term), Rufus S. Manley.

L. C. Datz becomes automatically a member of the Board of Direction, and the terms of Messrs. W. B. Gregory and Ole K. Olsen have not yet expired.

All of these gentlemen, with the exception of Mr. Manley, held office last year, and short biographical sketches of them were published in the February issue, 1915. A brief sketch of the professional life of Mr. Manley is herewith appended:

RUFUS SUMNER MANLEY was born September 27, 1878, at Junction City, Kansas. His early training was received in the public schools of his native state, and after graduation therefrom in 1897 he entered the United States Naval Academy at Annapolis. He was a student there at the outbreak of the Spanish-American War and got his first taste of actual warfare in the summer of 1898, when he served aboard the U. S. S. Harvard. He graduated from the Academy in 1901 and then followed the usual routine of the young officer in the service until 1906, when he resigned to enter commercial life. In November of the same year he was married to Miss Celestine Angela Brent of Pensacola, Florida. From that date until the present time Mr. Manley's professional career has been very closely associated with the creosoting business, in which he has always taken a prominent part. He was manager of the Gulfport Creosoting Company from 1906 to 1911, and from 1911 to date he has been President of the Creosoted Wood Block Paving Company of this city.

Mr. Manley has always taken a keen interest in the affairs of the Society and has done good service as a member of certain special committees, and his election to the three-year term upon the Board of Direction is an expression of appreciation on the part of his fellow members of his efficient work for the welfare of the Society.

The Proceedings.—This issue marks the beginning of the second year of the publication of our own journal, and it seems well to present here a few facts concerning the results of the first year of this new enterprise.

The Financial Report of the Secretary shows that the total revenues of the journal for the year just closed amount to \$1,500.75; this is made up principally of receipts from advertisers and of the sum of \$428.34 paid by the Society in the form of a \$2.00 subscription per year for each member. It is to be noted that many of the advertising contracts carry over into the year 1916, and this has been taken into account in figuring the receipts for 1915, only that proportion of each contract belonging to that year having been included in the item of total revenues above stated. The total expense of getting out the journal amounts to \$1,388.55. With six issues per year this brings the average cost of each issue to the sum of \$231.42. This figure includes every item of expense in any way connected with the journal, such as printing, postage, engraving, editor's salary, and stenographer's fees for reporting the discussions upon the technical papers read at the meetings.

The difference between receipts and expenditures shows a net balance to the account of the journal of \$112.20. During the last year of our connection with the Association of Engineering Societies we paid out to that association in the form of subscription to its journal the net sum of \$514.59. The net cost to the Society for our own journal has been \$316.14, or \$198.45 less than when we subscribed to the journal of the Association.

During the course of the year there have been published in the *Proceedings* nine technical papers and the discussions thereon; these with the editorial notes, book reviews, and business reports of the Society make up a volume of 366 pages. Several of the papers have been illustrated with maps, line drawings and half-tone cuts. Through the book reviewing column there has been added to the library a number of recently published volumes of engineering literature.

In the first issue of Volume I there were approximately eleven pages of advertisements, representing twenty firms and individuals; in the last or December issue of Volume I there were twenty-five and one-half pages of advertisements, representing fifty-five firms and individuals. These advertising pages are well worth the careful attention of our members, and wher-

ever possible we should endeavor to patronize the different firms who have thus been such a potent factor in the successful carrying out of this plan for publishing our own journal. It is gratifying to be able to record in this connection that out of a total of twenty advertising contracts which expired with the December issue all have been renewed with the exception of one or two. Several of these renewing have increased their space by one hundred per cent.

The Smoker.—Instead of following the usual custom of having a regular banquet this year, the President appointed a special committee, consisting of Mr. Ole K. Olesen and Mr. R. S. Manley, with power to determine the form which the annual entertainment should take and to proceed with the details of same. This committee decided to hold a "smoker" instead of the usual banquet, and to reduce the price by one dollar. In response to its call the committee received over one hundred acceptances, and on the evening of January eighth there gathered at the Cosmopolitan Hotel almost a hundred members and their guests, full of good cheer and eager with curiosity to know what "Ole" and "Doc" were going to pull off. It was specially worthy of note that all of the living Ex-Presidents were there with the exception of H. J. Malochée, who was out of the city on business.

Douglas Anderson officiated as Master of Ceremonies and from about nine-thirty that evening until the wee small hours of Sunday he was kept busy introducing the various stunts and speakers. To add an extra fillip to the Ojen cocktail, the evening's entertainment started off with some cabaret stunts by professional singers and dancers. It having been accidentally discovered that Prof. J. M. Robert had concealed on his person an emergency poem, prepared specially for this occasion, he was prevailed upon to read it, which he did, with apologies to "The Raven." The poem dealt quite cleverly with the idiosyncrasies of several of the prominent members of the Society. Mr. Datz, the retiring President, was next called upon to deliver his annual address, which proved to be a combination of serious thought and illuminating (United Gas and Electric) wit, illus-

trated with pictures of "has-beens" and accompanied by modern vaudeville music. In recognition of this stupendous effort on the part of Mr. Datz, of his past work for the Society, and of his approaching departure for other fields of labor, Mr. J. M. Robert was called upon to present him with a token of appreciation from the members. This present took the form of a handsome silver waiter and glass water set. No sooner had Mr. Robert begun his speech of presentation, however, than the proceedings were suddenly interrupted by Mr. Willie Williams, who contended that he had been promised the privilege of making that speech. So violent were his protestations that he and Mr. Robert finally came to blows, with the result that the handsome present was almost totally wrecked. After a search amid the ruins, however, Mr. Datz finally succeeded in rescuing intact one of the pieces, which turned out to be, with singular appropriateness, a stein.

As an off-set to this riotous affair Mr. Sam Young, the incoming President, was called upon to make a *few* remarks, which he did in his usual pleasing and graceful style, whereupon he was presented by Prof. W. B. Gregory, on behalf of the Society, with a handsome vegetarian bouquet.

The next number on the program was really the feature of the evening and consisted of a negro minstrel show presented by Messrs. Al. G. Fields, Geo. (Honey Boy) Evans, Billy Kersands, Geo. West, Geo. Thatcher, Lew Dockstader and Geo. Primrose, otherwise and variously known as Messrs. A. M. Lockett, Ole K. Olsen, A. W. Jackman, A. T. Dusenbury, J. M. VanDerveer, W. H. Williams, and R. S. Manley. These artists, in costumes both unique and appropriate to the occasion, entertained the assemblage with a succession of songs and jokes, grid-ironing many of the members of the Society and poking fun in a good-natured way at them for some of their most prominent characteristics. It would be impossible here to do justice to these songs and jokes by repeating them, and furthermore, it would not be necessary, for they will always remain fresh, or otherwise, in the memories of those who heard them. One feature, however, must not be passed over without a word of comment, and that was the interesting conglomeration of negro dialects presented, ranging

all the way from the pure nigger-negro of the South, through the Middle West—negro, and up to the Danish-negro dialect from the old country.

As invited guests of the Society we had with us Major Schulz and Major Caples of the U. S. Army Engineers, Mr. H. T. Wright, Naval Constructor, U. S. N., and Mr. Frank Churchill, the architect who has had charge of the remodelling of our Library room in the Cabildo. Each of these gentlemen upon being called upon for a speech responded in happy vein and in keeping with the spirit of the evening's entertainment.

In an effort to make amends to Mr. Datz for the *contretemps* in which his first present was destroyed, the Master of Ceremonies called upon Mr. J. Frank Coleman to make another presentation to him in the form of a handsome jewel case. When Mr. Datz received this present and opened the case, the gem therein sparkled so brilliantly that he was overcome with emotion and could only utter with the deepest feeling the one word "Stung!"

As the final musical number on the program Mr. "Ole Bull," the celebrated Norwegian Basso Soprano rendered a song the refrain of which was a pæan of praise for the wonderful boards which control the public utilities and other activities of the City of New Orleans.

On motion of Mr. J. F. Coleman a rising vote of thanks was extended to Messrs. Olsen and Manley and their associates for the very pleasant and enjoyable function; and then in accordance with our usual custom a silent toast was drunk to the memory of our members who have gone to the great beyond. This brought to a close one of the most successful social functions which the Society has ever undertaken.

Operation of the Cotton Warehouses.—Elsewhere in this issue will be found a very interesting paper by Mr. F. P. Breckenridge dealing with the operating features of the new cotton warehouses under the control of the New Orleans Board of Port Commissioners. This paper is not only interesting *per se*, but also from the fact that it in a way supplements Mr. von Phul's paper on the engineering features of the warehouses which was published in the June issue of the *Proceedings*. Mr. Brecken-

ridge's paper deals more particularly with matters of handling the cotton from the moment it arrives on the cars, with weighing, sampling and tagging it, and with the system of storing it. Results of operation so far show that the storage capacity of the warehouse compartments is being utilized as rapidly as the contractors are able to finish the different units, and even the most conservative and hide-bound of the old-time buyers and shippers are being rapidly converted to the improved methods of handling and storing, which are being worked out under the management and supervision of Mr. Breckenridge.

New Members.—The following additions to the membership of the Society have been made since our last issue:

RESIDENT MEMBERS.

Gail H. Browne, Hubbard M. Feild.

NON-RESIDENT MEMBERS.

Edward J. Henriques, Magnolia, Miss.

Henry A. Mentz, Magnolia, Miss.

Reginald McC. Schmidt, Gulfport, Miss.

TRANSFER FROM STUDENT TO NON-RESIDENT JUNIOR MEMBER.

Bernard H. Grehan, Chattanooga, Tenn.

NON-RESIDENT JUNIOR MEMBER.

M. A. Beranger, San Benito, Texas.

An Honor to Prof. Gregory.—It is always gratifying to record the recognition given to local engineers in the national engineering societies, and more particularly so when the man so recognized is a prominent and active member of this Society. Prof. W. B. Gregory has recently been appointed a member of the Nominating Committee of the American Society of Civil Engineers.

This is the second time that Prof. Gregory has been thus honored, he having been a member of the Nominating Committee of the American Society of Mechanical Engineers in 1912.

A Correction.—In the article by Professor Derickson on *The Reinforced Concrete Arch for Highway Bridges*, published in the December number, Vol. I, page 303, seventh line from the bottom of the page, there appears this statement—"These are some of the points urged against this form of construction, but there seems to be a fixed arch for locations" This should read as follows: "These are some of the points urged against this form of construction, but there seems to be a *quite general agreement that its use is preferable to that of the fixed arch* for locations where the span—."

BOOK REVIEWS

Field Engineering. (Seventeenth Edition, Revised and Enlarged.) By WM. H. SEARLES AND H. C. IVES. In One Volume, Pp. xxiii + 632. John Wiley & Sons. 1915. Price, \$3.00 net.

When there are a number of books devoted to the same subject the engineer is apt to select for use the one with which he became acquainted as a student. It will prove a source of much satisfaction to many to know that this well-known pocket-book dealing with the field operations of railroad engineering has been largely rewritten, increased and brought up-to-date.

The changes are stated to be as follows: In Chapters I, II, IV, V, VI, X, XVIII and XIX, while the changes made are few, they are important, taking up as they do the organization of the engineer corps, metric curves, and material on paper location. Chapter III giving valuable material on the theory of economy in grades and curves has been rewritten. Chapters VII, IX, XIII, XIV, and XV, which deal respectively with Reversed Curves, The Spiral, Earthwork Diagrams, and the Haul and Mass Diagram, are nearly or entirely new. The chapter of the previous edition on Construction has been expanded into three chapters headed Cross-Sections, Construction, and Track Laying, with the addition of new material. The net result has been to increase the book by some 150 pages, giving in all 309 pages of text and 331 pages of tables and diagrams.

In appearance the book remains the same as former editions, except that the name of Professor Ives appears as joint author with that of Mr. Searles. The well-deserved popularity is indicated by the statement on the title page to the effect that this is the Seventeenth Edition and Total Issue Fifty-Three Thousand.

DONALD DERICKSON.

Vest-Pocket Handbook of Mathematics for Engineers. (Second Edition—Rewritten and Enlarged). By L. A. WATERBURY, C. E., Professor of Civil Engineering, University of Arizona. Pp. x + 213. John Wiley & Sons, New York. 1915. Price \$1.50 net.

As its name implies this is a small leather-bound book about the size of a vest-pocket note-book. The author has selected certain subjects and formulæ in Mathematics and Mechanics, which he considers will be of the greatest usefulness to practising engineers, and has grouped them under separate headings, as follows:—

Algebra, Trigonometry, Analytic Geometry, Differential Calculus, Theoretical Mechanics, Mechanics of Materials, Hydraulics.

The second portion of the book contains Tables of Logarithms of Numbers, Logarithmic Sines and Cosines, Logarithmic Tangents and Cotangents, Natural Sines and Cosines, Natural Tangents and Cotangents, Conversion Factors.

The formulæ are well selected and well arranged, and the figures and printing are clear and distinct. The tables are very comprehensive and clear for such a small compass. It would appear to be a most excellent little book for any engineer who wished to have a handy reference book which he could easily carry about with him. D. A.

Handbook of Carburetion, By ARTHUR BENJ. BROWNE. .Pp. xi + 137. John Wiley & Sons, Inc., 1916. Price \$2.00.

This work is a very clear exposition of the many and varied problems connected with the subject of carburetion. The analysis of the subject is complete, and the conclusions arrived at, convincing. The book should be very interesting to all persons connected with the design and economical performance of automobile engines.

Besides the subject of carburetion, the book contains chapters on the design of intake manifolds, and on the practical testing of automobiles. The subject of practical testing is carefully gone into, road tests and laboratory tests included. Some of the testing methods employed originated with the author, and are in successful use at the Sheffield Scientific School of Yale University. JAMES M. ROBERT.

PAPERS AND DISCUSSIONS

ADDRESS OF THE RETIRING PRESIDENT,

By

L. C. DATZ.

Read before the Society January 8, 1916.

The first paragraph of a retiring President's address is very easily and quickly written. He has merely to blame Article IV, Section 1, of the Constitution for the necessity for the address, and the first paragraph is concluded.

Unfortunately for me, and doubly so for you, more paragraphs are to follow. These are not so easy for one whose greatest success in life has been dodging the lime light of speech making.

I find that I am very much handicapped in preparing this address by the presence of so many ex-Presidents of the Society here to-night, in that I am unable to embody herein as original, without being detected, the many good things they had in their addresses. Again, on account of the fact that the annual meeting last year was on January 14 and this year on January 8, a week earlier, I had only fifty-one weeks in which to prepare, while my predecessor, Mr. Williams, had fifty-two weeks. Consequently, if my address is light, full of gas and railroaded through, you will know the reason why.

I could, but won't, dwell upon the status of the engineer. Upon this aggravating subject so much has already been written as to make even our enlarged library facilities totally inadequate to shelve it all. Suffice it to say that while it is undoubtedly true that in the past the work of the engineer was not appreciated at its full worth, conditions are now rapidly changing. The engineer is being recognized as the backbone of the development of resources and wealth, and upon his technical knowledge of the physical forces of nature is dependent a nation's material progress. So that the engineer should rejoice in the fact that his work has never been as generally appreciated as at present, and with the widening of opportunities for employment, his

compensation is becoming more nearly commensurate with his work.

But I must pass on to what I really want to talk about to-night, and that is your Louisiana Engineering Society. A local engineering society, such as ours, can do much to aid in increasing the public estimate of the profession, and to hold it there. A local society, such as ours, can do everything to make it worth while to be a member. I do not doubt that the question is often asked by you, especially when you are writing your check for dues, "What do I get out of the society to justify my membership therein, and as a return for the dues I pay?" I consider that one of the greatest benefits derived from the society is the meeting of, and mixing with other engineers, getting that criticism and discussion advanced by them on papers read and afterwards published.

It is almost impossible for any man, even though he be at the top of his profession, to develop a plan, or project, that would be the last word in engineering design, one that would not be benefitted at times by criticism even of laymen. How much more so then, would criticism of his project be worth to him, if made by men of his own profession. To that end it has been our aim to provide an interesting and instructive paper at each meeting, and to follow same with a generous discussion, all of which is taken down by a stenographer and published in our Proceedings. The task of the Technical Paper Committee, of which Mr. Shaw is chairman, is not an easy one by any means. In its work of providing a program for each meeting it is likely to meet men who are too busy with their own private affairs to prepare papers; or to meet men who, having never done anything worth while, are afraid that some one will find it out; or to meet men who, having done something, are too modest to tell of it, or, are afraid of possible criticism of other engineers. I am one of those who believe that we really keep our education by giving it away, and in giving the benefit of our experience to others, we improve ourselves.

Along this line, we have undertaken to publish our own journal, and now after one year we leave it to your judgment as

to whether we have made a mistake in our undertaking, or in the selection of our editor, Douglas Anderson.

We have continued the good work started since we moved into our quarters in the Cabildo, to improve the library to such an extent that it would be of real value to the members, and one of the best libraries of its kind in the country. Sam Young, as chairman of the Library Committee, has done this work in his usual thorough way of doing things, and the only regret you should have in electing him President to-night is that you will lose him as chairman of the Library Committee. The additions to the library in the purchase of many books, and the extension of the library room and the improvements therein, to cost in the neighborhood of \$700.00, now under way, are made possible by the budget of \$40.00 per month to library purposes.

Then we kept the Membership Committee busy, of which John Riess was chairman. The work was strenuous, as there were some sixty applications to pass on, with which were given professional careers ranging from seven sheets of closely type-written matter to that of a few words.

All this meant work for the treasurer, Mr. Hunter Coleman, and the secretary, W. T. Hogg, and both have acquitted themselves well. Then too, in connection with the journal, the Publication Committee has done exceedingly well in securing advertisements for the journal, which are so necessary for the financial success of the undertaking. We all should recognize the value of these ads by patronizing our advertisers as much as possible.

I do not want to overlook the continued good work of Mr. Kokosky, as chairman of our Information Bureau this year, in locating work for unemployed engineers, and that of Mr. Baumbach, who recently announced that he was doing the same thing.

So, all in all, if our year has been a success, it is due to the work of these committees and officers.

There is one thing that I hope will be accomplished this coming year, and that is a better understanding between the engineering profession and the law regulating the practice of civil engineering, for the existence of which our society is responsible. The law was designed by the society to distinguish

between the engineer that may or may not be and the engineer that is, and with the hope that, eventually, existing imposters would be eliminated, and there would be a condition of affairs that would make it impossible for such to practice engineering. I feel that the Board of Engineering Examiners, through no fault of their own, have been seriously handicapped on account of the fact that the Governor has not filled vacancies existing on the Board, and it is probable that they will not be filled by our present executive. This condition should be remedied as soon as possible, so that the Board can carry out the provisions of the act regulating the practice of engineering, without such a serious handicap.

Speaking of the qualifications of an engineer, I once read what I thought was a good description characterizing him: "He ought to be able, if cast upon an unknown continent inhabited only by ignorant savages, to get to work, and so develop the natural resources of that country, that in a few years there would spring up in that wilderness cities with modern conveniences, linked together with steel lines of transportation, telephone and telegraph systems. There would be mills and mines, schools and churches, palaces and homes all over the land. Civilization would replace barbarism, and all this mighty change should come about because he who was marooned qualified as an engineer."

If the engineer can accomplish this, there is very little left that he cannot do; and yet big things are comparatively easy to accomplish if he will stick to the job. I, myself have carried through to a successful conclusion recently an accomplishment that was conceived by me some twelve months ago as almost impossible. The task was very arduous; quite a few engineers of prominence in this section of the country had to be interviewed and their coöperation assured. There were days when the job seemed hopeless. There were certain personal records of several deceased engineers to be obtained that were absolutely essential; I was surprised to find that so few of the engineers consulted had even a file copy of what I wanted, which was so closely identified with their very life work, that I knew that they alone could furnish it. However, they gladly had the data manu-

factured to accommodate me. Others of the engineers whom I consulted, kept several copies of this data on file and gladly gave me a copy. A few men gave me the best they had, but knowing each subject perfectly, I soon found out that their records were false, and would not do, so I was obliged to have them correct same. Even then I took no chances and had each man certify to the correctness of same with his signature.

The end I had in view was finally accomplished;—that of preserving my picture in a conspicuous place in the library of the society, but, you see, to do it with tact, I had to undertake the enormous task above. The result is that the new library walls will be decorated with a picture of every Ex-President of the society, from the venerable Sidney Lewis to one who is proud to have been included to-night in that group of men, all of whom have served the society well. Three of these have since answered the last call; the other fifteen, I hope, will serve the society from now on, to the end of making the Louisiana Engineering Society the best of its kind in the country.

I cannot close this without an acknowledgment of the deep appreciation I feel for having the honor of being your President this year. It has been a genuine pleasure for me to have served you, and to have worked with your Board of Directors, each member of which coöperated heartily with me to make this past year one of note in the history of the society, and although I am about to leave dear old New Orleans (with the accent on dear), I shall continue to have the interest of this society at heart.

OPERATING FEATURES OF THE NEW ORLEANS COTTON WAREHOUSES,

By

F. P. BRECKENRIDGE,

Read before the Society, November 8, 1915.

Mr. President and gentlemen of the Louisiana Engineering Society, if my recollection is correct, Mr. Von Phul has dwelt on the engineering features of the warehouses at your April meeting, so I will spare you any technical discussion and simply give you a few facts as to how the warehouses are being operated at the present time.

You probably remember that the first pile was driven for these warehouses on the 29th of January, of this year. By the first of September, three buildings, with a storage capacity for a hundred thousand bales of cotton, had been practically completed,—completed to the extent that we were using them and had stored in the buildings ten or fifteen thousand bales of cotton. Two of the compresses were completed and the third was practically completed, as we have been using two of the compresses almost every day since that time. One of the compresses is in use every day. Occasionally we receive enough flat cotton to use two compresses. The fourth compress, a high density compress, will be installed in about sixty days. The old line compresses press to a density of $22\frac{1}{2}$ pounds to the cubic foot, which is the requirement of steamers here in order to receive the ordinary rate of freight, while the high density compresses will give us a density of 35 pounds to the cubic foot. On the basis of the present freight to Genoa, say, of \$2.00 a hundred pounds, the agent will allow a reduction in the rate of about 15 or 20 per cent for cotton recompressed in the high density press, so that a shipper of cotton from here who has bought compressed cotton from the interior can recompress it at a cost, say, of 50 cents a bale, and on a 500-pound bale make a profit of a dollar and a half, merely on the recompressing, which is a pretty fair profit on the movement of the cotton itself. A great many bales go from this country to Europe on a profit of less than a dollar and a half a bale.

In addition to the three buildings which I have just mentioned, there are two other buildings which will be completed probably within thirty days. We are pushing the contractors gradually out of those buildings, and pushing Mr. Black every morning, to have him push the contractors. We are occupying at the present time, with cotton, almost every compartment in those two new buildings as they are being completed. I suppose we have ten or fifteen thousand bales in the new buildings at the present time. We have taken in altogether, since the first of September, or since the latter part of August, about 71,000 bales of cotton, and have moved out 5,500 bales, leaving us a stock of about 66,000 at the present time, and most of that cotton we have had to handle by hand methods. The cranes are installed in the first buildings that were completed, but in the most recent additions they have not yet been installed, so that the operation is not what it will be and what it should be. In the old buildings—I say the old, the older buildings—we have at the present time about half a dozen cranes which are in good operating condition. They were stiff at first and gave us some little trouble, possibly, but now they have been worked out and we find that we can do with a crane and three or four men work that it would take twenty men two or three times as long to do in the way of storing cotton. We can elevate from the floor to the top of a pile 10-high, one, two, three or four bales of cotton at a time, and in the shortest possible space of time. It is just the time necessary to hook on the bales and release them at the top. The operation of the crane causes practically no delay in the movement of the cotton at all.

In addition to the 230,000-bale storage capacity that I have already mentioned, the wharf house will be complete by the first of April, next, which will give us an additional capacity for a hundred thousand bales at shipside, which will enable us to give the ships the quick dispatch that Mr. Davis dwelt on in the paper you have just heard. We will assemble the cotton at the ship's side just as soon as we receive orders from the shippers to move it out of the warehouse, and in addition to that, there will always be some additional bales which will move from the warehouse to the ship's side after the ship arrives. The agents

have a way of holding up the freight until the last minute, always hoping that they can get higher rates for all of the cargo. Almost universally, there is a small movement at the tail end of the booking of a vessel, which goes in at a low rate, and hurriedly. In order to move that cotton from the warehouse to a ship's side, a distance of about a thousand feet, we have provided electric trucks, which will move on the elevated runways, and move it very rapidly, so that we should have no delay in the loading.

I don't know to what extent you are interested in the actual handling of the cotton. That is more or less a cotton man's business and one in which you are not directly interested, but I will give you a few brief facts as to how it is handled.

The first advice that we get of the arrival of the cotton at the warehouse is usually from the storer, who will tell us that he is shipping us, say, 500 bales of cotton of such and such a mark from such and such a point by such and such a railroad. We then get from the railroad what they call the billing reference, simply a duplicate of the freight notice to the storer, which gives us the number of bales and the marks of cotton in each specific car as it comes into town. The Stewart Brothers buy 500 bales of cotton in Greenville. They make out a bill of lading for 500 bales C. A. T. cotton, and they don't know the car number or anything about it. The railroad may put it in ten cars, or distribute it over twenty-five cars. The first knowledge of the cars that we have, we get from the railroad, so it is necessary for us to assemble that information that we get from the storer in some form, so that when we get the freight notices we can connect the storer's instructions with the arrival notices. When the car gets there, it is necessary for us to have proper tags, with the marks printed on the tags, or written on them, to be put on the cotton for identification purposes, sample papers, with the same marks stamped on them, and arrival and unloading sheets so that we can keep an accurate record of the cotton as it arrives, its condition, and any exceptions that we may make for the basis of claims on the railroad for damage or for over and short. Quite a number of cars come in with one or two bales of one mark over and one or two bales of another mark

short. They may show up with the proper number of bales, but a difference in the marks, due to careless loading, and in order to protect the shippers, it is necessary to take cognizance of these differences.

As soon as the cotton is tagged at the car doors, it is usually arranged for sampling. This sampling is done by officials of the New Orleans Cotton Exchange. We pay them, but that is a mere incident. The Cotton Exchange sees to that. And also the inspectors, who examine the cotton after it is sampled, to see whether the cotton is what they call a "mixed pack," two or three different kinds of cotton in the same bale, or to see whether it is wet, or damaged—a much more careful inspection than we give it at the car door. The inspection we give it is merely for railroad damage. The inspection they give it is to see the country damage on the cotton, and to see whether it is packed wet, or in any condition that will make it not marketable.

It is then usually weighed on arrival. A great deal of it goes into storage unweighed, but a good deal of it is weighed. We are trying to get all of the receivers of cotton to have all of their cotton weighed on arrival, the reason for that being that if they have the weights and the grades and samples before them, it is very easy to make a transfer of ownership with the cotton in store. In the old line method of handling cotton, it was practically an unknown proposition to have cotton transferred without taking it out of the pile, resampling it, reweighing it, inspecting it and handling it two or three times and putting it back, in order to make a change of ownership. I cannot see any reason why cotton should not change hands as grain or other commodities do, merely on the official classification of the Cotton Exchange and on the weights on arrival. Cotton that may be a trifle damp when it comes in there may require an allowance of 2, 5 or 10 pounds for moisture in the bale, which is very readily determined by experienced weighers. When I first become connected with the warehouse, in August, I had an idea that the cotton weigher was just a little better than just an ordinary average day laborer. After I had associated with the weighers and cotton men for a while, I found that they were about the highest paid arbitrators in town to-day. An expert cotton

weigher may make as much as \$10,000.00 per year weighing cotton for a number of different firms. His business is to find out the damp in the cotton and get an allowance for it. He is usually weighing for buyers, and the more moisture he can persuade the other weigher is in the cotton, the better weigher he is for the buyer, so it is largely a matter of the persuasive power of the weigher, and he is paid well for that.

We are trying to arrive at the weights at the warehouse, if the cotton is not wet, by one weigher. Any skilled weigher can come pretty close to telling whether there is half a pound or a pound or two pounds of moisture on the surface of a bale. If the cotton is really very wet, we have two weighers on it. If it is seriously damaged by water, we set it aside and open up the heads and dry it out and then weigh it; so that we try to be absolutely impartial as between the storer, or the seller, and the buyer, as to the weight of that bale and give them all as square a deal as we can, and it is on the basis of that that we hope to cut down very considerably the charges at the port of New Orleans for the handling of cotton.

The samples are split in two. A fair sample is taken from the bale, and half of it goes to the storer and half of it goes to the Cotton Exchange, where it is retained and held subject to the examination of possible purchasers, until such time as the bale actually leaves the warehouse and the cotton goes to the purchaser—the sample, I mean, goes to the purchaser. That gives the purchaser of the cotton, who may consider that the factor has padded out his sample and smoothed it down and hand-picked it a little, an opportunity to go to the Cotton Exchange and see a fair sample of the bale, without making it necessary to go to the warehouse and take that bale out of storage for inspection.

And not only one prospective buyer, but a dozen, can do the same thing. It is an excellent system, and I think it is going to be very satisfactory to the buyers as soon as they thoroughly understand it. There are some of the old line buyers, who have been doing business in the same way for thirty or forty years, who do not want a change, but I think they will have to, on a basis of expense. The man who will accept that

method of handling samples, as against the man who wants to draw his own samples, has an advantage of 30 to 40 cents a bale in the handling cost, and that thirty or forty cents a bale will very soon lead him away from the other method. His profits will be better, and he can do business on a smaller margin.

The compartments in the warehouse are all uniform. They hold 400 bales in a tier, four tiers to the compartment. We usually store the cotton ten-high; that is, ten bales piled on top of each other. If you should take a carload of cotton of 50 bales into the warehouse, we put six on the bottom and six more on top, and go right straight up with the pile, ten-high, or eight-high, or whatever is necessary to complete the carload. The next carload we store next to it. We don't put one on the ground and another on top of it. We try to pile each carload up in a separate pile, so that when it moves out, if it moves in carloads, as a great deal of it does, we don't have to disturb any other cotton except that which we wish to get out, and with the help of the cranes, the movement from the warehouse is very rapid and very satisfactory. In cotton that is received here uncompressed, however, there is a great deal of it that moves in very small lots. A man up there in Bunkie may ship in three bales of cotton to John M. Parker & Company, or W. B. Thompson, and those three bales will be sold as a separate lot for his account, and when they are sold it will be necessary to move them out separately, and they may be at the bottom. The engineers have devised a bale-pulling machine to use in connection with the crane, which will go into the pile and pull out any individual bale, without disturbing the pile. The remaining bales will arch above the bale that was pulled out to such an extent that the pile will not collapse until several bales have been withdrawn; then it will settle down gently and easily, but without disturbing it or causing it to fall over.

We have already made a number of transfers in the warehouse—paper transfers—on the strength of the new arrangements which we have perfected; that is, taking the weights on arrival and making the transfer merely one of transfer of warehouse receipt, and not taking the cotton out of the piles. We still have, however, a certain amount of the old form of doing

business, of getting the cotton out and having it resampled by the buyers. We charge 5 cents a bale extra over the cost of the handling for that privilege accorded to the buyers, to a certain extent to discourage the practice, and to a certain extent to cover the actual cost of handling. It really does not cover the actual cost of handling to us. I think the custom will die out. One of the largest receivers of cotton here, when he sent his first shipment to us, ordered us to hold that 250 bales, that he would sample it and inspect it and weigh it with his own men: he didn't want us to touch it at all. In the two weeks between the time that he notified us that he was ordering the cotton to us and the time that the cotton arrived there, he evidently talked to other men on the Cotton Exchange, and we were very much pleased to have him write us, unsolicited, that he had decided not to send his own men up there, that he would take our samples, inspection and weight. I say "our." It is really official Cotton Exchange sampling, inspection and weighing, because all of those men are appointed by the Cotton Exchange. The Dock Board has nothing to do with the selection of any of the men who draw the samples or do the inspecting or the weighing. We can discharge them if they don't do their duty properly, but we can't select the men who take their places. The clerical men at the warehouse are all selected by civil service methods. A Civil Service Commission was provided by law which created the warehouse, one of the members of which comes from the Board of Trade, one from the Cotton Exchange and one from the Dock Board. Those three men held examinations in August, at which more than two thousand men appeared and took the examinations for the various classes of service, and out of the two thousand, I think about 75 per cent turned in papers of a sort, and an eligible list of the ones who passed, about four hundred, has been prepared, and from that list the Dock Board selects the clerical employees that they desire, to carry on the business of the warehouse. For the other labor, we are using just the men who come to us and apply for work. There is no question of unionism or non-unionism up there; it is an open shop. We have men who belong to the Cotton Rollers' Association, and screwmen and longshoremen—all classes of men working for us

up there, and we have had no trouble whatever with our labor and getting plenty of labor, and at reasonable prices,—about the same prices that the railroads pay at their terminals for similar classes of labor.

At the present time, all shipments from the warehouse are moved to the city front wharves, from Louisiana avenue down to Canal street, for shipment, owing to the incomplete state of our own wharf. We are moving large lots by the Belt, putting 50 bales or more in the car, and for the small lots, we have two Packard trucks, with which we can handle 17 bales of compressed cotton at a time. They make very good time, so that we can deliver 100 to 150 bales with each truck a day, comfortably, so all the small lots we contemplate handling in that way.

The principal economies which will result from these warehouses, which I can see after three months' connection with them, will be the transfers in the warehouse without reweighing, which I have already dwelt on, the lower insurance rate, which will be about 25 cents per hundred pounds per year when the plant is completed, and the lower cost of compressing. We are compressing cotton for 40 cents up there to-day, as against 50 cents in any of the old line compresses.

Now, I don't want to bore you with any more details, but if there are any questions that any of you gentlemen would like to ask as to the condition of the warehouse at the present time, or any other matters in connection with it, I will be very glad to endeavor to answer them to the best of my ability. If it is something that I am not familiar with, I will make Mr. Black work. He will know the technical end of it.

DISCUSSION UPON "OPERATING FEATURES OF THE NEW ORLEANS COTTON WAREHOUSES."

THE PRESIDENT: Gentlemen, I am sure we all enjoyed this very interesting talk of Mr. Breckenridge's, and I think he will be glad to have any questions asked him. If anybody would like to question Mr. Breckenridge or Mr. Black, we shall be glad to hear from them. The subject is now open.

MR. BILLINGSLEY: Mr. Breckenridge, are they using that new device—I mean for extracting the cotton from the piles? Has that been in use here?

MR. BRECKENRIDGE: Yes, sir; we have used that quite frequently.

MR. BILLINGSLEY: That is what makes it possible to store it as high as you do?

MR. BRECKENRIDGE: Yes. In the old line warehouses, it was really stored some seven tiers high—seven rows high. It was found very uneconomical to do so, because if you wanted to get out any bale at the bottom, you had to move the whole pile to get to a bale at the bottom. And with us, it would simply ruin us if we didn't have some way of extracting a single bale where we have it at the bottom of a pile. The cost would be prohibitive to operate in that manner. But there is no question in my mind that that machine is a very simple device. It simply moves the two upper bales and lifts, as well as pulls, at the same time. It is a balanced pull. The same rope that pulls out the bales runs over two sheaves and lifts up on the whole apparatus, and lifts the bale above it as it pulls the bale out. It is partially a lifting of the entire pile and partially a slight compression of the bales immediately above the one to be pulled and the one above that. I should say it is more compression than lifting. It isn't necessary to lift the whole pile, even when it is pressed in the compress. You know, when you put cotton through a compress, it is squeezed down to about 9 inches, and springs up again to about 18 or 19, sometimes 20, so that there is always a considerable compression possible in the bale after it has once been compressed, and that is what makes the puller practicable,

in my mind, more than the lifting of the weight of the entire tier of cotton.

MR. BILLINGSLEY: I should judge, from what you said about the way you are piling cotton there, that you will probably use your puller only on a very small percentage there of the total amount of cotton that goes in.

MR. BRECKENRIDGE: Very small. The cotton that comes in to us in lots of fifty or a hundred bales, or a thousand bales, goes out very much in the same lots. It is factors' cotton, the cotton that comes in here from nearby points, not compressed—we may have a carload that comes in with 30 bales of flat cotton in it; there may be seven or eight marks of cotton in that one car, and we have to store this in bulk; we can't make separate piles for those small marks; we just have to trust to luck that they will be sold together. If we had 20 bales to get out of a pile of 50, we wouldn't bother with the puller, we would go right at the pile, and lift aside with the crane the few bales that were in the way and go after it and root for it.

PROFESSOR ROBERT: Mr. Breckenridge, does that puller injure the bale in any way?

MR. BRECKENRIDGE: Not at all. We have long flat hooks that simply go in between the bales and turn around behind the one to be pulled out—simply catch behind the bale; it doesn't injure the fabric at all.

PROFESSOR ROBERT: There is no catching at the sides of the bale?

MR. BRECKENRIDGE: Not at all.

MR. YOUNG: Have you kept any tab of the time it takes to get a bale out?

MR. BRECKENRIDGE: I should judge three or four minutes, when things are running smoothly. The only time we have had any trouble with the puller at all is when we have piled cotton on two 4 by 4 skids to keep it up from the ground, and the bales are resting on those skids. Mr. Black cursed vigorously every morning for a while, when we had put it that way and couldn't get it out, but we very readily found a way to get them out. We simply pulled a bale out over the one that we wanted to pull, or pulled two bales away from the one that we wanted, and

then pulled the bale that we wanted out afterwards. Nothing will work where you put cotton on two 4 by 4's; so in order to obviate any trouble of that sort in the warehouses we operate, we put down 4 by 4's with skids crosswise. As a matter of fact, I don't think there is any necessity for putting skids under the cotton. That is something in which Mr. Black and I have bowed to the judgment of the old cotton men, who insist that cotton will damage if it is any way close to the ground. Now, that ground there is 22 feet deep in river sand, and we have got about 8 to 10 inches of clam shells on top of that, and if there is any way for dampness to get to that cotton, I don't see how it can do it. But we don't wish to be criticised for any possible damage to the bales, and so we skidded it for that reason, and that is the only thing that gives us any trouble in getting the bales out.

MR. YOUNG: You say you have handled about 71,000 bales?

MR. BRECKENRIDGE: Yes, sir.

MR. YOUNG: What do you figure you will handle this year?

MR. BRECKENRIDGE: I should think 400,000 bales. The storm of September 29 was about the best advertising that we could have very well picked up. Prior to that time, we didn't know just how much business we could comfortably do up there—how much people would clamor for this space, or whether we would have to go out and clamor for cotton; but the storm of September 29 settled that. It took the roof off of every old line compress in town and put them out of business about 30 days, and some of them are still out of business, and it gave us such a vast volume of business—it gave us practically everything for a while that had been going to the old line compresses, and now the trouble has been to keep up with the business. We have at the present time about 200 cars on track ahead of us to unload, and we are unloading about 50 a day. When the warehouses are complete, we will be able to unload 200 cars a day very readily and put it in storage and sample it, inspect it and weigh it.

MR. LEET: How does that transfer table work which I understand you have in use up there in carrying cranes to the piles?

MR. BRECKENRIDGE: We don't contemplate using the crane transfers for the transferring of cotton at all. That is simply for the movement of the cranes and transfer of equipment. We have 16 cranes on the ground up there and will have them distributed among the buildings, but we can concentrate all the 16 cranes in one building if we want to; so that if any crane broke down, it would be a matter of five or ten minutes to run another crane in from another compartment to the one in which we wished to operate it, and run the broken down one out of the way for repairs.

MR. DERRICKSON: We hear a good deal about the advisability of holding cotton for a rise in price. What does it cost to store a bale, say one year, in the warehouse?

MR. BRECKENRIDGE: A bale of uncompressed cotton coming into warehouse is received, packed, sampled, inspected, weighed, compressed and stored for 85 cents for the first month, which includes also delivery to wharf, railroad or team if it is moved out within the first thirty days. Each subsequent month is 8 cents, so that you have 85 cents plus 88 cents for the first year. The compressed cotton that comes in there is 55 cents for the first month and 8 cents for each additional month. There is a cheaper storage rate than that on round lots. If a man wants to put in multiples of 50 bales, we will take it for 40 cents for the first month, where no operation of sampling, weighing or inspecting is performed—simply put it in as a storage—cotton that may have been bought on sample or by the personal representative of the buyer in the interior and brought here and merely held.

MR. DERRICKSON: Is insurance included in that?

MR. BRECKENRIDGE: Insurance is not included. We have nothing to do with the insurance—except, we have something to do with the insurance to this extent, that the rate published by the Louisiana Fire Prevention Bureau at the present time is 75 cents per hundred dollars for a year. The Dock Board desires to see that all shippers and storers are in exactly the same position in their operations with the warehouse now, as much as possible, as would be the case if the warehouses were complete. In other words, they don't wish to penalize the trade for the

failure to have the warehouse completed in time for this cotton season. By using the word "failure," I don't mean that there was any real failure; it was simply the fact that they didn't start on the thing until it was physically impossible to complete it for this season. We really were in there almost before the buildings were ready for us. The Dock Board is absorbing at the present time the difference in insurance between 75 cents and 30 cents, just as we are paying the drayage or belt charges from the warehouse to the city front on cotton that is going out to the ship. We will not do that after the first of April, when the wharf is completed. It will either go out over our own wharf, or the shipper can dray it, himself, to any place that he wishes. We will make the delivery either over our own wharf, or to a team or to the Belt, for the same price, after the first of April. Now, we are absorbing about 15 cents a bale in getting that cotton to the city front.

MR. CAPPELL: How do you get the bale from the car to the warehouse?

MR. BRECKENRIDGE: The most primitive method known—"the nigger and the hand truck." There is nothing that can beat it. Simply right down to primitive methods. We have tried electric trucks and cranes and everything else, and there is nothing that is as economical and as efficient as the nigger and the number five Fairbanks truck.

MR. CAPPELL: You have found nothing that can take the place of this what you call the primitive method?

MR. BRECKENRIDGE: Not for a 30-foot haul. For a short-haul operation, that has the machines beat.

MR. CAPPELL: Do you think you will in time come to an elevated track from which you could handle the bales direct, by gravity?

MR. BRECKENRIDGE: To shipside?

MR. CAPPELL: No—

MR. BRECKENRIDGE: From the cars into the warehouse? No, for the reason that the bale has to stop in transit between the car and the warehouse, to be sampled. It has to be put down on the pavement somewhere, and the sampler cuts a hole in it and takes out about a pound of cotton and wraps it up and



Discussion Upon Operating Features of Cotton Warchouses 31

puts a sample tag on it, and in that operation it is necessary to make one stop between the freight car and the compartment, and for two short hauls we find that the hand trucks are better than anything else we have tried.

MR. WEIL: Are there any restrictions as to dimensions of the bales you receive?

MR. BRECKENRIDGE: We will receive any size bale that may be tendered to us. The average bale is 500 pounds. I think the average for the last year was around 488 pounds—something like that—for the crop. We have bales come in to us as low as 350 pounds. With the ordinary compress, which is made to compress a bale of 500 pounds, the jaws will not come any closer together than about 9 or 10 inches, so that it is impossible to put the same density on a bale of 350 pounds as it is on a 500-pound bale, and we have had several bales rejected this season, very light bales, at shipside, as not being compressed to the proper density. That simply means a penalty of 50 cents a bale on the owner of the cotton.

MR. WEIL: I didn't mean the weight of the bale, but the over-all dimensions.

MR. BRECKINRIDGE: They are practically the same as a standard size gin box, in which there is very little variation. Some of the old gins have different sized boxes, but they run about the same—27 inches wide by 54 inches long is the standard size gin box, and when a bale is compressed, it comes out about 29 or 30 by 58 to 60. The compression flattens it out and compresses it at the same time. That is where the high-density press differs from the other. The high density press holds it in on the four sides first, and then the bottom comes up and it can't spread. It is compressed very much more tightly and from all four directions, instead of only from two.

MR. WEIL: Is there any penalty for oversize?

MR. BRECKINRIDGE: Yes, sir. The New Orleans Steamship Association has rules, which are the same as those that were adopted by the South Atlantic and Gulf Steamship Conference, and they have rather arbitrary rules as to what they will accept and will not accept without penalty. It has to be compressed to a density of $22\frac{1}{2}$ pounds to the cubic foot, and if it is short

of that, they penalize the bale 50 cents, or you can take it back and recompress it. The cost of taking the bale back from the wharf and recompressing it and sending it back to the wharf is considerably greater than the 50 cents, so usually the 50 cents is paid. In addition to that, they have other penalties—a dollar a bale for oversize—if it runs over 60 inches long or over 30 inches wide.

MR. MANLEY: What is the form of warehouse receipt?

MR. BRECKENRIDGE: The position of the Steamship Agents' Association—and it is a position which will probably be attacked by the cotton interests in the very near future—is that they will not make allowance for the average density of the entire lot of cotton that has an average density of 26 pounds per cubic foot, and they will take 98 bales of it and throw out the only two light bales in the lot; and that is something that is manifestly unfair.

Mr. Manley asked about the warehouse receipt. Our form of warehouse receipt was drawn up after a number of conferences with the attorneys for the New Orleans Clearing House Association and with the large banks in New Orleans, and has been since then submitted to the attorneys and the management of the Federal Reserve Bank here and in Washington, and in New York, and it has also been submitted to the large banks in New York, Chicago, St. Louis, Kansas City, Cincinnati and other points in the North, who are apt to lend money on cotton warehouse receipts, and I understand that some of the banks here are at the present time placing money at as low as 4 per cent on cotton for the banks in New York. There is no 4 per cent money in the New Orleans banks, but the banks in the North which have a surplus are placing that money here, through their correspondents, at 4 per cent, with the better known cotton firms, who have a credit standing, as well as who have cotton.

MR. MANLEY: What are the principal features of that warehouse receipt?

MR. BRECKENRIDGE: It is an ordinary warehouse receipt. It is "Received in store the following: 50 bales cotton, as per marks and numbers shown herein, and deliverable only to John Doe & Company, or Order, upon returning this receipt, properly endorsed." It has the schedule of charges printed on the back,

according to the Uniform Warehouse Receipt Law, and in the margin it has a place for the marks and numbers of the bales. We simply put on that our tag numbers, which is the only identification of the bale. There are no duplicate numbers in our series of tag^s

MR. CAPPELL: A little question as to the technical side. Your compartments are divided off in such a way that should there be a fire in one, it can be cut off entirely from the others?

MR. BRECKENRIDGE: Each compartment is entirely separate from every other compartment.

MR. CAPPELL: Has it automatic fire doors?

MR. BRECKENRIDGE: No, but the doors open straight out in the air. No two compartments open into each other.

MR. CAPPELL: But these openings, in case of a fire in one compartment, would they close automatically?

MR. BRECKENRIDGE: No. We would probably open them just as rapidly as we could and get a line of hose in there, in addition to the automatic fire extinguishers. There is an automatic fire sprinkler in every compartment—on every gallery we have them, and even on the runways. The entire plant is sprinkled at every possible point, and in addition to that, they have hose connections, 2½-inch hose outlets, at intervals along the sides of the warehouse, and the engineers are providing at the present time chemical fire extinguishers, and on each corner of each building there is a monitor with a 6-inch stand pipe going to the roof.

I didn't mention that there will be a pumping plant on the wharf when it is completed, which, instead of giving us a 60-pound pressure, that we get from the city mains at the present time, will give us a pressure of 250 pounds, which will take care of any fire we are apt to have there.

MR. WEIL: Will that be a standard form of fire pump?

MR. BRECKENRIDGE: I respectfully refer to Mr. Black for reply.

MR. BLACK: Electric centrifugal pump.

MEMBERSHIP LIST.

RESIDENT MEMBERS.

Figures in brackets () show date of election to the Society.
(C. M.) Charter Member, 1898.

- JAMES R. ADAMS, (1911), Engineer, with State Board of Engineers, 213 N. O. Court Bldg., New Orleans.
- LESTER F. ALEXANDER, (1915), Engineer and Contractor, 834 Audubon Bldg., New Orleans.
- DOUGLAS S. ANDERSON, (1909), Professor of Electrical Engineering, Tulane University, New Orleans.
- JOHN S. BARELLI, (1908), Machinery and Power Plant Equipment, 612 Godchaux Bldg., New Orleans.
- WADE BARNETT, (1910), Ass't. Engineer, Sewerage and Water Board of New Orleans, 1220 St. Charles Ave., New Orleans.
- FREDERIC N. BILLINGSLEY, (1915), Resident Engineer and Manager, White Lake Land Co., Gueydan, La.
- JAMES W. BILLINGSLEY, (1914), Consulting Engineer, Interstate Bank Bldg., New Orleans.
- A. L. BLACK, (C. M.), Engineer with Ford, Bacon & Davis, 921 Canal St., New Orleans.
- A. MERRICK BLAMPHIN, (1908), Engineer in Charge, West End Lake Shore Park, Room 19, City Hall, New Orleans.
- WALTER P. BRANDIN, (1907), Ass't. Engineer, N. O. & N. E. R. R., 1726 Elysian Fields Ave., New Orleans.
- GAIL H. BROWNE, (1915), Engineer with Ford, Bacon & Davis, 921 Canal St., New Orleans.
- R. T. BURWELL, (1908), Chief Inspector, Gulf Department, Hartford Steam Boiler Inspection & Insurance Co., 833 Gravier St., New Orleans.
- C. GLENN CAPPEL, (1915), Bridge and Office Engineer, State Highway Dept., 104 N. O. Court Bldg., New Orleans.
- E. WHEELER CARR, (1908), President E. W. Carr, Inc., Contractors and Engineers, Heating, Ventilating, Power Plant Piping, etc., 425 Gravier St., New Orleans.
- E. HUNTER COLEMAN, (1911), Ass't. Engineer with J. F. Coleman, Consulting Engineer, 920 Hibernia Bldg., New Orleans.
- J. F. COLEMAN, (C. M.), Consulting Engineer, 920 Hibernia Bldg., New Orleans.
- SCHUYLER P. COLEMAN, (1915), Engineer with John A. Kruse Engineering Co., 1446 Nashville Ave., New Orleans.
- J. A. COMMAGERE, Jr., (1915), Inspector, U. S. Engineers, 1800 Bayou Road, New Orleans.
- W. H. P. CREIGHTON, (1912), Dean of College of Technology and Professor of Mechanical and Sugar Engineering, Tulane University, New Orleans.
- HORACE E. CRUMP, (1912), Engineer, with N. O. Ry. & Light Co., 201 Baronne St., New Orleans.
- B. N. DAVIS, (1913), Engineer and Contractor, 301 Magazine St., New Orleans.
- GEO. H. DAVIS, (1909), Member of Firm of Ford, Bacon & Davis, 921 Canal St., New Orleans.
- JOHN C. DE ARMAS, (1912), Engineer, Buras Drainage District, 7735 Cohn St., New Orleans.
- EUGENE F. DELERY, (1915), Engineer and Draftsman, Sewerage & Water Board of New Orleans, 2007 Laharpe St., New Orleans.

- DONALD DERICKSON, (1912), Head of School of Civil Engineering, Tulane University, New Orleans.
- JACQUES DE TARNOWSKY, (1915), Contracting Engineer, 826 Perdido St., New Orleans.
- J. L. DICKEY, (1915), Contracting Engineer, 8004 Hickory St., New Orleans.
- A. A. DIETTEL, (1911), Engineer with Engineering Department, Public Belt Railroad, 321 Audubon St., New Orleans.
- M. P. DOULLUT, (1911), Member of Firm of Doullut & Williams, Civil Engineers and General Contractors, 1016 Hibernia Bldg., New Orleans.
- ALLAN T. DUSENBURY, (1909), Vice-President and Chief Engineer, Louisiana Meadows Co., 236 Baronne St., New Orleans.
- GEORGE G. EARL, (1900), General Superintendent, Sewerage and Water Board of New Orleans, City Hall Annex, New Orleans.
- JOHN T. EASTWOOD, (1901), Principal Assistant Engineer Sewerage and Water, Sewerage and Water Board of New Orleans, City Hall Annex, New Orleans.
- HUBBARD M. FEILD, (1915), Contracting Engineer, 4941 St. Charles Ave., New Orleans.
- E. A. FOWLER, (1903), Engineer with Sewerage and Water Board of New Orleans, City Hall Annex, New Orleans.
- CHAUNCEY FRENCH, (1908), First Vice-President, Woodward, Wight & Co., Ltd., Constance and St. Joseph Sts., New Orleans.
- MARCEL GARSAUD, (1905), Engineer with Hampton Reynolds, General Contractor, Tulane Ave., and John St., New Orleans.
- JAMES M. GEARY, (1915), General Contractor, 305 Baronne St., New Orleans.
- HAROLD H. GIBSON, (1915), Chief Engineer, N. O. & Gr. Isle R. R., Algiers Ry. & L. Co. and N. O. Western R. R., 222 Elmira Ave., New Orleans.
- WILLIAM B. GREGORY, (1907), Professor of Experimental Engineering; Irrigation Engineer, U. S. Dept. of Agriculture; Tulane University, New Orleans.
- L. H. GUERIN, (1908), Consulting Engineer, 305 Baronne St., New Orleans.
- FARRAR P. HAMILTON, (1915), Paving Engineer, Southern Pine Assn., 600 Interstate Bank Bldg., New Orleans.
- W. J. HARDEE, (C. M.), City Engineer, City Hall, New Orleans.
- CHAS. J. HARDY, (1909), Resident Engineer, Ford, Bacon & Davis, 921 Canal St., New Orleans.
- H. M. HARRIMAN, (1915), Supt. Gas Dept., N. O. Ry. & Lt. Co., Magnolia and Gravier Sts., New Orleans.
- M. V. HAULARD, (1906), Supt. of Track, N. O. Ry. & Lt. Co., 4154 Iberville St., New Orleans.
- WALTER H. HOFFMAN, (C. M.), Civil Engineer, Chess, Checkers and Whist Club, Canal and Baronne Sts., New Orleans.
- W. T. HOGG, (1913), Instructor in Civil Engineering, Tulane University, 1545 Sixth St., New Orleans.
- HENRY L. HUTSON, (1911), Secretary, A. M. Lockett & Co., 533 Baronne St., New Orleans.
- A. W. JACKMAN, (1913), 1st. Lient. U. S. Army, Retired, 4714 Pitt St., New Orleans.
- LOUIS JACOBY, (1915), Engineer, with Westinghouse Electric & Mfg. Co., 835 Maison Blanche, New Orleans.
- ERNEST LEE JAHNCKE, (1900), President, The Jahncke Navigation Co., 814 Howard Ave., New Orleans.

- PAUL F. JAHNCKE, (1908), Vice-President, The Jahncke Navigation Co., 814 Howard Ave., New Orleans.
- WARREN JOHNSON, (1903), P. O. Drawer 241, New Orleans.
- E. A. JOHNSTON, (1914), Draftsman, Doullut & Williams, 319 S. Lopez St., New Orleans.
- CHARLES E. JOUBERT, (1909), Superintendent, Hampton Reynolds, General Contractor, 838 Broadway, New Orleans.
- J. P. KEMPER, (1909), Civil Engineer in Private Practice, 810 Whitney Bldg., New Orleans.
- CHARLES M. KERR, (1914), Assistant State Highway Engineer of Louisiana, 104 New Orleans Court Bldg., New Orleans.
- FRANK M. KERR, (C. M.), Chief State Engineer of Louisiana, 213 N. O. Court Bldg., New Orleans.
- JOHN KLORER, (1898), Ass't. State Engineer, Board of State Engineers, 213 N. O. Court Bldg., New Orleans.
- HERMANN KOKOSKY, (1903), Member of Firm of Kokosky & Co., 614 Gravier St., New Orleans.
- W. P. LANGWORTHY, (1914), Resident Engineer, John A. Kruse Engineering Co., 606 Hibernia Bldg., New Orleans.
- G. W. LAWES, (1898), Secretary, Board of State Engineers, 213 N. O. Court Bldg., New Orleans.
- J. H. LEWIS, (1908), Engineer, U. S. Engineer Office, Q. & C., Bldg., New Orleans.
- SIDNEY F. LEWIS, (C. M.), Chief Engineer, Board of Levee Commissioners, Orleans Levee District, N. O. Court Bldg., New Orleans.
- A. M. LOCKETT, (1900), President, A. M. Lockett & Co., Ltd., 533 Baronne St., New Orleans.
- GERVAIS LOMBARD, (C. M.), Ass't. State Engineer, Board of State Engineers, 213 N. O. Court Bldg., New Orleans.
- E. B. MCKINNEY, (1898), Superintendent of Power, N. O. Ry. & Lt. Co., 1323 Octavia St., New Orleans.
- HENRY J. MALOCHEE, (1898), District Selling Agent for American Engineering Co., Erie Pump and Equipment Co., Nelson Valve Co., Vulcan Soot Cleaner Co., Yarnall-Waring Co., 917 Hennen Bldg., New Orleans.
- RUFUS S. MANLEY, (1912), President Creosoted Wood Block Paving Co., 301 Q. & C., Bldg., New Orleans.
- SIDNEY L. MENGE, (1909) Manager, Irrigation Dept., Woodward, Wight & Co., Ltd., Constance and St. Joseph Sts., New Orleans.
- JOHN H. MURPHY, (1914), 1322 Felicity St., New Orleans.
- FRANK A. MUTH, (1915), Ass't. Superintendent, Lighthouse Service, 2323 Short St., New Orleans.
- A. J. NELSON, (1900), Practicing Engineer and Architect, second floor Liverpool & London & Globe Annex, New Orleans.
- BERNARD S. NELSON, (1911), Engineer with A. M. Lockett & Co., 533 Baronne St., New Orleans.
- WILLIAM T. NEWTON, (1915), Supt. U. S. Engineer 4th Miss. River Dist., 921 Antonine St., New Orleans.
- ROBERT M. O'BRIEN, (1916), Supt. of Equipment, N. O. Ry. & Lt. Co., 5315 Camp St., New Orleans.
- CHARLES W. OKEY, (1911), Senior Drainage Engineer, U. S. Dept. of Agriculture, Tulane University, New Orleans.
- FOSTER OLROYD, (1901), City Electrician, 516 Pelican Ave., New Orleans.
- OLE K. OLSEN, (1905), Contracting Engineer, 822 Perdido St., New Orleans.

- J. DEVEREUX O'REILLY, (1912), Engineer Board of Port Commissioners, Liverpool & London & Globe Bldg., New Orleans.
- H. A. PALLFELT, (1914), Civil Engineer, Standard Oil Co. of La., P. O. Box 1250, New Orleans.
- ARSENE PERRILLIAT, (C. M.), Consulting Engineer, and Managing Engineer Hercules Co., Ltd., 821 Hibernia Bldg., New Orleans.
- H. P. PORTER, (1915), Engineering Sales Work, (A. M. Lockett & Co., Ltd.), 722 Ann St., New Orleans.
- ALFRED RAYMOND, (1900), General Manager Drainage Operating Department, Sewerage & Water Board of New Orleans, 503 City Hall Annex, New Orleans.
- C. T. RAYNER, Jr., (1909), 2116 Canal St., New Orleans.
- LYMAN C. REED, (1907), Vice-President and Manager of the United Electric Sales Co., 821 Union St., New Orleans.
- HAMPTON REYNOLDS, (1910), General Contractor, 823 Maison Blanche, New Orleans.
- JOHN REISS, (1906), Engineer and Contractor, 503 Hibernia Bldg., New Orleans.
- JAMES M. ROBERT, (1908), Associate Professor of Machine Design, Tulane University, 2432 Calhoun St., New Orleans.
- GEORGE H. RUGGLES, (1914), Engineer with Ford, Bacon & Davis, 921 Canal St., New Orleans.
- F. J. SCHWAB, (), 201 Baronne St., New Orleans.
- ARTHUR M. SCOTT, (1915), Engineer with Ole K. Olsen, 822 Perdido St., New Orleans.
- J. H. SEAMAN, (1912), Salesman, Westinghouse Elec. & Mfg. Co., 2618 Coliseum St., New Orleans.
- G. ARTHUR SEAVER, (1911), Office Engineer with Geo. J. Glover, General Contractor, 2011 Marengo St., New Orleans.
- CHAS. H. SHAPLEIGH, (1915), Ass't. Engineer to Assistant to the President, N. O. & N. E. R. R., 1002 Q. & C. Bldg., New Orleans.
- JAMES S. SHARP, (1915), Resident Engineer, N. O. & N. E. R. R., 816 Burdette St., New Orleans.
- A. M. SHAW, (1910), Consulting Engineer, 1001 Hibernia Bldg., New Orleans.
- JOHN A. SILSBEE, (1915), Engineer with Trans-Mississippi Terminal R. R. Co., 3923 Carondelet St., New Orleans.
- MATTHEW S. SLOAN, (1915), 1306 Octavia St., New Orleans.
- CHAS. E. SNYPP, (1911), Gretna, La.
- EDGAR L. STREAM, (1915), Consulting Engineer, Vaccaro Bros. Co., New Orleans.
- ALFRED F. THEARD, (C. M.), Principal Assistant Engineer in charge of Drainage, Sewerage & Water Board of New Orleans, City Hall Annex, New Orleans.
- FRANK J. TRELEASE, (1916), Engineer with Ford, Bacon & Davis, 921 Canal St., New Orleans.
- PAUL UHLICH, (1906), 201 Baronne St., New Orleans.
- HARRY L. VILLERE, (1915), Ass't. Engineer, Board of Port Commissioners, 1354 St. Bernard Ave., New Orleans.
- WALTER P. VILLERE, (1909), Engineer with Board of State Engineers, 213 N. O. Court Bldg., New Orleans.
- WILLIAM von PHUL, (1908), member of firm of Ford, Bacon & Davis, 921 Canal St., New Orleans.
- FRANK H. WADDILL, (1898), 407 Tulane-Newcomb Bldg., New Orleans.
- J. D. WALKER, (1908), Ass't. City Engineer, Room 21, City Hall, New Orleans.
- JACKSON W. WATERS, (1915), Superintendent A. G. Thomas, 2611 Canal St., New Orleans.

- ALFRED L. WEBRE, (1913), Mechanical Engineer, 643 Magazine St., New Orleans.
- BEN WILLARD, (1900), Local Manager, General Electric Co., Malson Blanche Bldg., New Orleans.
- WM. H. WILLIAMS, (1908), Member of Firm of Doullut & Williams, Civil Engineers and Contractors, 1016 Hibernia Bldg., New Orleans.
- THOMAS L. WILLIS, (1907), Principal Assistant City Engineer, City Hall, New Orleans.
- VICTOR L. WILLOZ, (1900), Superintendent of Distribution, New Orleans Ry. & Lt. Co., 201 Baronne St., New Orleans.
- R. C. WILSON, (1911), Consulting Engineer, 4927 Perrier St., New Orleans.
- PEYTON W. WOOD, (1911), 201 Baronne St., New Orleans.
- A. A. WOODS, (1911), Superintendent, N. O. & N. E. R. R., Press and Levee Sts., New Orleans.
- DURALD F. WOODS, (1915), Assistant Engineer, City of Gretna, 2618 Coliseum St., New Orleans.
- W. B. WRIGHT, (C. M.), Division Engineer, Sewerage & Water Board of New Orleans, 506 City Hall Annex, New Orleans.
- SAMUEL YOUNG, (1911), Member of Firm of Guerin & Young, Consulting Engineers, 305 Baronne St., New Orleans.
- HENRY L. ZANDER, (1898), Parish Engineer for Jefferson Parish, Engineer 1st and 2nd Good Roads Districts, Engineer 2 and 5 unit 4th Jefferson Drainage Districts, 821 N. Rampart St., New Orleans.

NON-RESIDENT MEMBERS.

- WM. E. ATKINSON, (1911), State Highway Engineer, 104 N. O. Court Bldg., New Orleans.
- CHAS. D. BABBITT, (1911), Private work and Real Estate, Gueydan, La.
- J. G. BENNETT, (1913), Temporary Ass't. U. S. Drainage Engineer for Florida, Ft. Pierce, Florida.
- J. H. BERNHARD, (1913), President, Inland Navigation Co., 52 Broadway, New York.
- JOSEPH P. BERANGER, (1915), Chief Engineer and Superintendent, Ansonia Sugar Co., Azua, Santo Domingo.
- C. W. BOCAGE, (1909), Civil Engineer, Houma, La.
- EDWARD W. BRES, (1915), Inspector, U. S. Engineers, 12th floor Q. & C. Bldg., New Orleans.
- R. W. BRINGHURST, Jr., (1912), P. O. Box 192, Alexandria, La.
- HENRY F. CAMERON, (1914), General Manager, Lake Charles Railway, Light & Water Works Co., Lake Charles, La.
- L. C. DATZ, (1906), Engineer Southern Properties, United Gas & Electric Engineering Corporation, 21st and 1st Ave., Birmingham, Ala.
- A. D'HEUR, (C. M.), Vice-President and General Manager, Kern Trading & Oil Co., 105 Flood Bldg., San Francisco, Cal.
- LEANDER P. ELBERSON, (1911), Crowley, La.
- FRANK E. EVERETT, (1914), Drainage Engineer, Franklin, La.
- CHAS. H. FENSTERMAKER, (1914), Chief Engineer, Industrial Lumber Co., Chief Engineer, Road District No. 5, Allen Parish, La., Elizabeth, La.
- FRANCIS T. FOOTE, (1909), Kaplan, La.
- LOUIS J. FORTIER, (1914), Junior Civil Engineer, U. S. War Department, U. S. Engineer Office, Custom House, New Orleans.
- FRED. I. GETTY, (1915), Manufacturer of Oil Well and Water Well Supplies, Strainers, Pumps, etc., 603 Cutting Ave., Jennings, La.
- C. H. GILLEAN, (1912), 1625 Second St., New Orleans.
- W. A. HALLER, (1913), Engineer with Federal Light & Traction Co., 60 Broadway, New York.

- EDWARD J. HENRIQUES, (1915), Ass't. Engineer with Xavier A. Kramer, Consulting Engineer, Magnolia, Miss.
- E. S. JARRETT, (1909), President, Jarrett Chambers Co., Inc., 30 East 42nd St., New York.
- XAVIER A. KRAMER, (1911), Consulting Engineer, Magnolia, Miss.
- EUGENE W. KERR, (1911), Baton Rouge, La.
- L. A. LOUSTALOT, (1913), Franklin, La.
- THOS. WATTS MADDUX, (1914), Engineer with Brookhaven Gravel Co., Brookhaven, Miss.
- C. C. MARTIN, (1905), Engineer with The L. A. Boulay Co., 1250 Nicholas Bldg., Toledo, Ohio.
- THOMAS A. MEANS, (1914), Member of Firm of Symmes, Means and Chandler, Agricultural Engineers, 58 Sutter St., San Francisco, Cal.
- HENRY A. MENTZ, (1915), Engineer with Xavier A. Kramer, Consulting Engineer, Magnolia, Miss.
- ARTHUR R. MIELLY, (1915), Engineer on Federal Valuation, Sante Fe Ry., Galveston, Tex., care Chief Engineer.
- H. F. McDERMOTT, (1915), District Sales Manager, Wm. Wharton Co., Inc., of Philadelphia, 1880 Continental & Commercial Bank Bldg., Chicago, Ill.
- CHAS. S. McFARLAND, (1903), Burnside, La.
- WM. C. OLSEN, (1914), Resident Engineer for Gilbert C. White, Consulting Engineer, P. O. Box 56, Durham, N. C.
- GUY OSBORNE, (1913), Engineer, Black River Cypress Co., Sardinia, N. C.
- BOYKIN W. PEGUES, (1907), Professor of Civil Engineering, Louisiana State University, Baton Rouge, La.
- HENRY N. PHARR, (1908), Olivier, La.
- H. A. PHILIPPI, (1912), Superintendent of Construction, U. S. Engineer Office, Vicksburg Engineer District, P. O. Box 421, Vicksburg, Miss.
- W. B. ROBERT, (1911), Parish Engineer, Opelousas, La.
- ERNEST A. ROSE, (1915), Erath, La.
- JOHN A. SALMEN, (1911), Slidell, La.
- T. H. SAMPSON, (1900), Helena, Ark.
- REGINALD McC. SCHMIDT, (1915), Inspector, U. S. Quartermaster Department, 1023 Leontine St., New Orleans.
- GEORGE SELMAN, (1908), 615 N. 4th St., Monroe, La.
- JAMES SHERRARD, Jr., (1910), Ass't. Engineer, American Bridge Co., Erecting Dept., 1712 Widener Bldg., Philadelphia, Pa.
- FRANK SHUTTS, (1909), Lake Charles, La.
- FRED. N. SHUTTS, (1913), Parish Engineer, Calcasieu Parish, Lake Charles, La.
- FRED. E. SMITH, (1916), Resident Engineer, State Highway Dept. of La., P. O. Box 146, Baton Rouge, La.
- REINIER SWART, (1898), Baton Rouge, La.
- IRA W. SYLVESTER, (1901), Consulting Engineer, City Hall Bldg., Alexandria, La.
- W. A. VAUGHN, (1912), City Asphalt Chemist, 503 Antoine St., St. Joseph, Mo.
- J. A. THORNTON, (1911), Morgan City, La.
- WM. F. TRIGGS, (1914), District Sales Manager, Buckeye Traction Ditcher, P. O. Box 157, Lake Charles, La.
- THOS. H. TUTWILER, (1898), Engineer, Memphis Railways Co., Memphis, Tenn.
- GEORGE D. WADDILL, (1911), Junior Engineer, U. S. Engineer Office, 5219 Camp St., New Orleans.
- ALLEN WASHBURN, (1908), Port Eads, La.

W. S. WHITE, (C. M.), 918 Parkerson Ave., Crowley, La.

MAYBIN H. WILSON, (1912), Ass't. Engineer, Northwestern Pacific R. R.,
P. O. Box 220, Sausalito, Cal.

ASSOCIATE MEMBERS.

R. H. BAUMBACH, (1911), Manager, Eugene Dietzgen Co., 615 Common St., New Orleans.

EDWIN C. BROWN, (1915), Traveling Salesman, 4215 Locust St., Kansas City, Mo.

H. W. FLETCHER, (1914), Manager, Clyde Iron Works, 416 Carondelet St., New Orleans.

JULES GODCHAUX, (1899), Raceland, La.

BYRON LYONS, (1914), Engineer with Board of State Engineers, 1503 Carrollton Ave., New Orleans.

EDWIN L. POWELL, (1914), President, New Orleans Cuban Steamship Co., 802 Canal Bank Bldg., New Orleans.

ROGER B. QUINCY, (1915), Manager, New Orleans District, Robert W. Hunt & Co., Engineers, 1022 Hibernia Bldg., New Orleans.

JOHN J. STEADHAM, (1912), Supervisor of Bridges & Buildings, N. O. & N. E. R. R., 1228 Music St., New Orleans.

F. W. STEVENS, (1909), Manager, New Orleans District Sales Office, Allis-Chalmers Mfg. Co., 719 Maison Blanche, New Orleans.

STILLMAN W. WHEELLOCK, (1914), Manager of Sales, Carnegie Steel Co., 1030 Maison Blanche, New Orleans.

NON-RESIDENT ASSOCIATE MEMBERS.

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

RESIDENT JUNIOR MEMBERS.

EDWARD S. BRES, (1911), Engineer in Charge of Construction, Chef Menteur-Rigolets Highway, 6104 Hurst St., New Orleans.

JAMES J. BULLIUNG, (1915), Draftsman, N. O. Ry. & Lt. Co., 2815 Washington Ave., New Orleans.

EDWARD W. BURBANK, (1911), Engineer, Allis-Chalmers Mfg., Co., 4822 Prytanla St., New Orleans.

ASHLEY CALONGNE, (1914), with S. A. Calongne & Sons, Paving Contractors, 403 Hibernia Bldg., New Orleans.

A. HAROLD DELBERT, (1913), Engineer with Orleans Levee Board, 4730 Prytanla St., New Orleans.

GEO. E. DURR, (1914), Engineer, General Fire Extinguisher Co., 2200 Canal St., New Orleans.

RALPH EARL, (1913), Engineer, doing experimental hydraulic work under personal employ of Geo. G. Earl, New Orleans.

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

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

FRANK L. HOLT, (1915), Draftsman, N. O. Ry. & Lt. Co., 201 Baronne St., New Orleans.

WILHELM E. KOCH, (1913), Asst. Engineer, Sewerage & Water Board of New Orleans.

RICHARD B. KOHNKE, (1911), Ass't. Engineer, Sewerage & Water Board of New Orleans, 2506 Berlin St., New Orleans.

HERBERT P. NATHAN, (1913), 3004 Prytanla St., New Orleans.

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

HYMAN RABINOVITZ, (1911), Ass't. Engineer, Sewerage & Water Board of New Orleans, 2832 Baronne St., New Orleans.

- EDWIN T. RUSSELL, (1911), 2120 Canal St., New Orleans.
LUCIEN J. TROXLER, Jr., (1915), Engineer with United Gas & Electric Co., 505 Jena St., New Orleans.
LEO S. WEIL, (1912), In Machinery Business, Office 710 Whitney Bldg., 5117 Prytania St., New Orleans.
THOS. WHITE, (1912), Engineer with American Creosote Works, P. O. Sta. B., New Orleans.
J. NORMAN WILSON, (1911), Ass't. Engineer, Sewerage & Water Board of New Orleans, 2823 Dante St., New Orleans.
BURRIS D. WOOD, (1911), Civil Engineer, Submarine Contractor, 314 Pine St., New Orleans.

NON-RESIDENT JUNIOR MEMBERS.

- G. C. BADGER, (1913), Engineer with General Fire Extinguisher Co., 4706 Magnolia Ave., Chicago, Ill.
M. A. BERANGER, (1915), Ass't. Engineer, San Benito Sugar Mill, Borderland Sugar Corp., San Benito, Tex.
ALVIN M. FROMHERZ, (1915), Student, Post-Graduate Work, Marquette University, Milwaukee, 183 Fourteenth St., Milwaukee, Wis.
BERNARD H. GREHAN, (1914), Engineer with U. S. Engineer Office, Municipal Bldg., Chattanooga, Tenn.
EUGENE M. HORNOT, (1912), Electrical Engineering Student, Western Electric Co., 3633 N. Harding Ave., Chicago, Ill.
JACOB F. MULLER, Jr., (1912), Engineer, and Ass't. Secretary and Treasurer United Gas & Electric Eng. Corp., 21st St. and 1st Ave., Birmingham, Ala.
CHAS. L. JACOB, (1911), Engineer with Jarret-Chambers Co., Paris, Idaho.

STUDENT MEMBERS.

- CHAS. H. BROOKSHIRE, (1913), 1217 St. Roch Ave., New Orleans.
JOHN A. BROOKSHIRE, (1911), 1217 St. Roch Ave., New Orleans.
JOHN CALLAN, (1911), 1712 Baronne St., New Orleans.
F. B. ELLIOT, (1911), 1815 Ursuline Ave., New Orleans.
EDWIN F. EMMER, (1915), 3800 Burgundy St., New Orleans.
JAMES P. EWIN, (1915), 1040 Audubon St., New Orleans.
A. N. GOLDBERG, (1914), Superintendent Levee Construction, H. W. Bond & Bro., 2616 Peniston St., New Orleans.
EUGENE C. HAWKINS, (1915), 1234 Henry Clay Ave., New Orleans.
NORMAN A. HOTARD, (1913), 235 Laverne St., New Orleans.
PENDLETON E. LEHDE, (1913), 2223 Magazine St., New Orleans.
EDWARD LEVI, (1915), 8223 Panola St., New Orleans.
WILLIAM B. MONROE, (1915), 847 Carondelet St., New Orleans.
SHEPARD F. PERRIN, (1915), 1421 Napoleon Ave., New Orleans.
ROBERT A. PIERPONT, (1915), 1036 Napoleon Ave., New Orleans.
ROBERT R. PORTERFIELD, (1915), 1040 Audubon St., New Orleans.
GREEN RIVES, (1915), 1905 Calhoun St., New Orleans.
FRANK R. SHAW, (1913), Engineer with Galveston Wharf Co., Galveston, Tex.
WILL SMARDON, (1913), Franklin, La.
FRANK E. SPRAGUE, (1912), 802 Peters Ave., New Orleans.
LEO STECKLER, (1914), Engineer with Gas Dept. N. O. Ry. & Lt. Co., 2007 Baronne St., New Orleans.
WILLIAM STECKLER, (1913), 2007 Baronne St., New Orleans.
CLIFFORD H. STEM, (1914), Estimator in Eng. Dept., Cumberland Telephone Co., 7933 Panola St., New Orleans.
HORACE M. WHITE, (1915), 1537 Calhoun St., New Orleans.

SUMMARY.

Resident Members	122
Non-resident Members	56
Associate Members	10
Non-resident Associate Member.....	1
Junior Members	21
Non-resident Junior Members.....	7
Student Members	23
Total	240

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	L. C. Datz.....	1915

Vice Presidents.

C. H. Chamberlin.....	1898-1899	J. T. Eastwood.....	1908
Alf. F. Theard.....	1900	John Riess	1909
J. F. Coleman.....	1901	John Reiss	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	Samuel Young.....	1915

Secretary and Librarian.

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

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. DeBuvs.....	1902	Ole K. Olsen.....	1912-1913
W. H. Hoffman.....	1903, 1904, 1905	E. H. Coleman.....	1914-1915
J. C. Haugh.....	1906-1907		

Directors.

Thos. L. Raymond.....	1898	John Riess	1907-1908
A. C. Bell.....	1898-1899	W. B. Gregory.....	1909

F. T. Llewellyn.....	1898	Marcel Garsaud.....	1908-1909-1910
Frank M. Kerr.....	1899-1900	J. W. Armstrong.....	1909-1910
Henry J. Malochee.....	1899	A. M. Lockett.....	1910
T. H. Tutwiler.....	1900-1901	A. M. Shaw.....	1911-1912-1914
Ernest D. Ivy.....	1900-1901-1902	L. C. Reed.....	1910-1911-1912
Alf. Raymond	1901-1902	D. S. Anderson.....	1911-1913
John M. Ordway.....	1902-1903-1904	W. B. Gregory.....	1912-1913-1914-1915
A. C. Duval.....	1903-1904-1905	L. C. Datz.....	1912-1913-1914
W. McCorkindale.....	1903	A. T. Dusenbury.....	1913-1914
C. W. Wood.....	1904-1905-1906	Ole K. Olsen.....	1915
E. L. Jahneke.....	1905-1906-1907	W. H. Williams.....	1915
H. B. Richardson....	1906-1907-1908		

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.
 JOHN T. NORTON, R. M., July, 1905.
 FRANCIS V. PELLERIN, R. M., March 31, 1908.
 JUDGE JOHN CLEGG, Assoc. M., October 5, 1908.
 JOHN MORSE ORDWAY, Hon. M., July 4, 1909.
 HENRY B. RICHARDSON, C. M., August 22, 1909.
 CHARLES W. WOOD, R. M., 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.

ABRIDGED CATALOGUE OF BOOKS IN LIBRARY, JANUARY 1,
1916.

Construction

- Building Construction and Superintendence, Parts I and II.—Kidder.
- Handbook of Construction Plant—Dana.
- Materials of Construction—Johnson.

Concrete

- Concrete, Plain and Reinforced—Taylor & Thompson.
- Concrete Costs—Taylor & Thompson.
- Concrete Construction—Gillette & Hill.
- Concrete and Reinforced Concrete Construction — Turneure & Maurer.
- Properties of Reinforced Concrete—Martin.
- Reinforced Concrete Construction, Vols. I and II—Hool.

Masonry.

- Bulletin No. 108, Am. Ry. Engs. & M. of W. Association.
- Foundations for Bridges and Roofs—Jacoby & Davis.
- High Masonry Dams—Morrison & Brode.
- Masonry Construction—Baker.
- Retaining Walls for Earth—Howe.
- Subaqueous Foundations—Fowler.

Steel

- Design of Highway Bridges—Ketchum.
- Design of Steel Mill Buildings—Ketchum.
- Graphical Analysis of Roof Trusses—Greene.
- Influence Lines for Bridges and Roofs—Burr & Falk.
- Modern Frame Structures, Parts I and II—Johnson, Bryan & Turneure.
- Planning and Construction of High Office Buildings—Birkmire.
- Roofs and Bridges, Parts I, II, III, IV—Merriman & Jacoby.
- Steel Structures—Morris.

Timber

- The Preservation of Structural Timber—Weiss.
- Structural Details—Jacoby.

Electricity

- Electric Power Plant Engineering—Weingreen.
- Elements of Electrical Engineering. Direct Currents—Franklin & Esty.
- Long Distance Electric Power Transmission—Hutchinson.
- Hydro-Electric Practice—von Schon.
- Hydro-Electric Plants—Beardsley.
- Steam Electric Power Plants—Koester.

Gas

- Handbook of Carburetion—Browne.
- Gas Manufacture—Hornby.
- Gas Power—Junge.
- Internal Combustion Engines—Carpenter & Diedrichs.
- Valves and Valve Gears, Vol. II, Gasoline, Gas and Oil Engines—Furman.

Irrigation and Drainage

Engineering for Land Drainage—Elliott.
Irrigation—Newell.
Irrigation Engineering—Wilson.
Practical Irrigation—Newell.
The Conservation of Water by Storage—Swain.
The Regulation of Rivers—Van Ornum.
Working Data for Irrigation Engineers—Moritz.

Law.

Engineering and Architectural Jurisprudence—Wait.
Law and Contracts—Wait.
Municipal Franchises, Vols. I and II—Wilcox.

Mathematics

Calculus—Courtenay.
Calculus of Finite Differences—Boole.
Conic Sections—Drew.
Engineering Mathematics—Steinmetz.
Handbook of Mathematics for Engineers—Waterbury.
Logs—Saxton.
Logarithms—Vegas.
Tables—Smoley.
Mathematical Examination Questions—Christie.
Partial Differential Equations—Airy.
Theory of Equations—Todhunter.
Trilinear Coordinates—Ferrer.

Mechanics

Analytical Mechanics—Bartlett.
Elementary Mechanics—Parkinson.
Elements of Mechanics—Nystrom.
Hydro-Mechanics—Besant.

Miscellaneous

Physical Tables—Smithsonian Institution.
Corrosion and Preservation of Iron and Steel—Cushman & Gardner.
Cements, Limes and Plasters—Eckel.
History of the Jetties—Corthell.
Engineering Geology—Ries & Watson.
Engineering Mathematics—Steinmetz.
Life and Life-work of Charles B. Dudley—Am. Soc. Test. Mat.
Modern High Explosives—Eissler.
Paint Technology and Tests—Gardner.
Public Utilities—Hayes.
Investigating an Industry—Kent.
Efficiency—Emerson.
Engineering of Shops and Factories—Tyrell.

Pocket Books

American Civil Engineers' Pocket Book—Merriman.
American Electricians' Handbook—Croft.
Architects' and Builders' Pocket Book—Kidder.
Civil Engineers' Pocket Book—Frye.
Civil Engineers' Pocket Book—Trautwine.
Cane-Sugar Manufacturers' and 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.

Field Engineering—Searles and Ives.

Structural Engineering Handbook—Ketchum.

Railroads

Economic Theory of Railway Location—Wellington.

Economics of Interurban Railways—Fischer.

Field Engineering—Searles.

Freight Terminals and Trains—Droedger.

Railroad Curves and Earthwork—Allen.

Railroad Location Surveys and Estimates—Lavis.

Roads

The Modern Asphalt Pavement—Richardson.

Roads and Pavements—Baker.

Road Preservation and Dust Prevention—Judson.

Street Pavements and Paving Material—Tillson.

Highway Engineering—Blanchard-Drowne.

Sewerage and Drainage

Elements of Sanitary Engineering—Merriman.

Handbook of Sanitation—Price.

The Separate System of Sewerage—Staley & Pierson.

Sewer and Drains—Marston.

Sewerage—Folwell.

American Sewerage Practice—Metcalf & Eddy.

Specifications

Association for Standard Paving Specifications, Fourth Annual Report.

Elements of Specification Writing—Kirby.

Engineering Contracts and Specifications—Johnson.

Specifications for Street Roadway Pavements—Whinery.

Standard Specifications—Ostrup.

Steam

Economy in the Sugar Factory—Abraham Bayle.

Engineering Thermodynamics—Lucke.

Experimental Engineering—Carpenter & Diederichs.

Heating—Baldwin.

Heat Energy and Fuels—Juptner.

Machine Design—Jones.

Mechanical Engineering of Power Plants—Hutton.

Pumping by Compressed Air—Ivens.

Quick Rules for Heating and Ventilating—Baldwin.

Refrigerating Machinery—God.

Steam Electric Power Plants—Koester.

Steam Power Plants—Meyer.

Steam Power Plant Engineering—Gebhard.

Steam Power Plant Piping—Morris.

Steam Turbines—French.

Transmission Calculations—Rosenthal.

The Design of Steam Boilers and Pressure Vessels—Haven & Sweet.

Steam Boiler Economy—Kent.

Properties of Steam and Ammonia—Goodenough.

Surveying

Draughtsman's Alphabets—Esser.

Free Hand Lettering—Daniels.

Principles and Practice of Surveying, Vols. 1 and II—Breed & Hosmer.

Topographical Drawing—Daniels.

Valuation

Engineering Valuation of Public Utilities and Factories—Foster.

Investigating an Industry—Kent.

Public Utilities—Hayes.

Valuation of Public Service Corporations—Whitten.

Water Power

Hydraulic Motors and Turbines—Bodmer.

Hydro-Electric Development—Player.

Hydro-Electric Plants—Beardsley.

Hydro-Electric Practice—von Schon.

Hydro-Mechanics—Besant.

Water Power Engineering—Mead.

Water Supply

Clean Water and How to Get It—Hazen.

Elements of Sanitary Engineering—Merriman.

Filtration of Public Water Supplies—Hazen.

Public Water Supplies—Turneaure & Russell.

Towers and Tanks for Waterworks—Hazlehurst.

River Discharge—Hoyt & Grover.

Water Filtration Works—Fuentes.

Water Supply Papers

35, 36, 37, 38, 39, 77, 78, 79, 80, 81 to 111, 113 to 122, 124 to 135, 137 to 142, 163, 345 E, Prof. Paper (U. S. G. S.) 86.

The Library contains the following volumes of Magazines:

*American Architect, 24, 25, 59 to 107.

American Electrician, 12, 13.

American Machinist, 15, 16, 17, 21, 22, 23.

†Association of Engineering Societies Journal, 21, 22, 24 to 54.

Brickbuilder, 7, 8, 9, 10, 19 to 24.

Concrete, 8, 9, 10, 11, 12.

†Concrete-Cement Age, 1 to 6.

Electrical Engineer, 25, 26.

†Electric Journal, 3 to 11.

*Electric Railway Journal, 32 to 46.

Street Railway Journal, 14 to 18, 24 to 31.

*Electrical World, 33 to 66.

Engineering, 53 to 74.

*Engineering and Contracting, 24 to 43.

Engineering Digest, 3, 4, 5, 6, 7.

†Industrial Engineering and Engineering Digest, 10 to 14.

Engineering Index, 1884-1914.

†Engineering Magazine, 7 to 49.

*Engineering News, 32 to 43, 45 to 74.

Index to Engineering News, 1874-1909.

*Engineering Record, 37, 39 to 72.

†General Electric Review, 10 to 18.

Iron Age, 49, 50, 51, 52, 54.

Mechanical World, 5 to 18.

†Municipal Engineering, 12 to 48.

*Power, 13, 14, 15, 18 to 42.

*Railway Age Gazette, 31 to 58.

- †Stone & Webster Public Service Journal, 1 to 16.
Transactions, American Society of Civil Engineers, 40, 42 to 76.
Index to Transactions American Society of Civil Engineers, Vols. 1 to 74.
University of Illinois Bulletins, Vols. 4 to 11.
University of Wisconsin Bulletins, Vols. 1 to 6.
Proceedings of the American Railway Engineering Association, 1910 to date.
Proceedings American Institute of Electrical Engineers, 1910 to date.
Proceedings of the American Society for Testing Materials, Vols. I to XII.
Proceedings of the American Society of Municipal Improvement, 1910 to date.

The Library receives regularly the proceedings of the following Societies:

- American Road Builders' Association.
- American Society of Civil Engineers.
- American Wood Preserves' Association.
- Boston Society of Civil Engineers.
- Brooklyn Engineers' Club.
- Cleveland Engineering Society.
- Engineers' Club of Baltimore.
- Idaho Society of Civil Engineers.
- Maine Society of Civil Engineers.
- Ohio Society of Mechanical, Electrical and Steam Engineers.
- Engineers' Society of Pennsylvania.
- Engineers' Club of Philadelphia.
- Engineers' Club of Dayton, Ohio.
- Pacific Northwestern Society of Engineers.
- North Dakota Society of Engineers.
- Western Society of Engineers.

*Received weekly.

†Received monthly.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

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

Ballots for the election of new members were opened. There were 53 formal ballots and 2 informal ballots. The following were elected:

Resident Members—Gail H. Browne, New Orleans; Hubbard M. Feild, New Orleans.

Non-Resident Members—Edward J. Henriques, Magnolia, Miss.; Henry A. Mentz, Magnolia, Miss.; Reginald McC. Schmidt, Gulfport, Miss.

Transfer from Student to Non-Resident Junior Member—Bernard H. Grehan, Chattanooga, Tenn.

Non-Resident Junior Member—M. A. Beranger, San Benito, Tex.

A communication from Mrs. B. S. Nelson was read. Mrs. Nelson stated that she no longer considered herself a member of the Society, as circumstances prevented her from attending the meetings. It was moved and carried that Mrs. Nelson's resignation be considered as accepted December 31, 1914.

Resignations of Messrs. Albert J. Phillips and Henry E. Chambers, Jr., were accepted with regret.

The financial report of the Secretary, showing a cash balance, after all bills are paid, of \$843.47, was read and accepted.

Mr. Young stated that the contemplated improvements to the library room would cost approximately \$700. It was moved by Mr. Dusenbury, and carried, that the Library Committee be authorized to spend approximately \$700 to improve the library room in accordance with the plans of Mr. Frank G. Churchill, architect, and that the matter be referred to the Society for approval.

A list of the present Junior and Student members of the Society was submitted by the Secretary. It was moved and carried that the Junior members who have been Juniors for three years or more be requested to change to full members, in accordance with the by-laws of the Society. It was moved and carried that Student members be required to change to Junior or Full membership at the end of the year in which they graduated.

It was moved and carried that the badges of the Society be sold at a fixed price plus the cost of engraving.

The following bills were approved for payment:

Dameron-Pierson Co., binder and ledger sheets, stat. acct.....\$ 6.75
F. D. Daubert, refreshments (November meeting), refr. acct..... 10.50

Tulane University Press, printing, stat. acct.....	16.00
W. T. Hogg, Secretary, salary December, incidentals, sec. acct.....	25.05
There being no further business, the meeting adjourned.	

W. T. HOGG, Secretary.

Regular Meeting of the Society, December 13, 1915.

The meeting was called to order with President Datz in the chair and The minutes of the last meeting were read and approved.

Mr. Young, chairman of the Library Committee, stated that the Library Committee had expended during the past year approximately \$450 for the purchase of new books, and now that we have a good working library, the greatest need at present is an improvement to the room and equipment of the library. Mr. Young stated that the committee estimated that approximately \$700 would be required for the improvements contemplated, and asked that the Society approve the proposed expenditure. It was moved by Mr. J. F. Coleman, seconded and carried, that the Library Committee be authorized to spend the proposed sum in improving the library. The motion was carried unanimously.

The technical exercises of the evening were then held. Mr. Burris D. Wood read a very interesting paper entitled "Modern Diving and Wrecking Methods on the Mississippi."

The nominations of officers for the year 1916 were then held. The ballots were cast as follows:

For President—	1st Ballot
Samuel Young	20
Ole K. Olsen.....	5
W. B. Gregory.....	1
R. S. Manley.....	1
	—
	27

For Vice President—	1st Ballot
A. T. Dusenbury	16
Ole K. Olsen.....	4
R. S. Manley.....	3
James M. Robert.....	1
G. W. Lawes.....	1
H. L. Hutson.....	1
	—
	27

For Secretary—	1st Ballot
W. T. Hogg.....	14
James M. Robert.....	7
E. H. Coleman.....	2

A. W. Jackman.....	1
G. A. Seavers.....	1
Ole K. Olsen.....	1

—
26

For Treasurer—	First Ballot
E. H. Coleman.....	18
A. W. Jackman.....	3
Ole K. Olsen.....	2
H. L. Hutson.....	2
Jas. M. Robert.....	2

—
27

For Director (to serve 3 years)—	1st Ballot	2nd Ballot
R. S. Manley.....	11	21
A. M. Shaw.....	6	5
Jas. M. Robert.....	3	—
D. S. Anderson.....	2	1
A. T. Dusenbury.....	1	—
W. B. Gregory.....	1	—
W. H. Williams.....	1	—
	—	—
	25	27

President Datz stated that it was customary at the December meeting of the Society to decide whether there should be a banquet or some other form of entertainment in connection with the annual meeting. It was moved by Mr. James M. Robert and seconded by Mr. W. H. Williams, that a banquet be held in connection with the annual meeting. Mr. J. F. Coleman offered a substitute motion: "That the Chair appoint an entertainment committee to determine whether we shall have a banquet, smoker, or some other form of entertainment." Mr. Coleman's motion was seconded and carried.

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

W. T. HOGG, Secretary.

Annual Meeting of the Board of Direction, January 8, 1916.

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

Minutes of the last meeting were read and approved.

The annual reports of the Secretary and Treasurer were submitted and accepted. The Treasurer's report showed a balance, January 1, 1916, of \$703.11, and the Secretary's report showed collections from January 1, 1916, to date, \$326.75, making a total of cash on hand \$1,029.86.

The Secretary's report showed a balance in the General Fund, after appropriating one-half of 1915 balance to Library Fund, of \$354.75.

The resignations of Messrs. M. S. Sloan, John Titzel, Samuel J. Dill and Anderson Offutt were read. Mr. Sloan's resignation was laid over. The resignations of Messrs. Titzel, Dill and Offutt were accepted with regret.

The matter of dropping several members who had not paid any part of their 1915 dues was laid over to the next regular meeting. The question of changing certain Student and Junior members to higher grades was laid over to the next regular meeting.

The following bills were approved for payment:

E. M. Norman, collections.....	\$22.70
F. Daubert, refreshments, December.....	10.50
Tulane University Press, printing.....	64.90
Lake Bros., umbrella.....	10.00
L. C. Datz, paid to janitor.....	5.00
Eng. & Contr., subscription.....	2.00
Engineering Record, subscription.....	2.50
Electrical World, subscription.....	3.00
W. T. Hogg, Secretary (sal. incl.).....	23.55

The following applications were ordered to ballot subject to the approval of the Membership Committee:

Resident Membership—Robert M. O'Brien, Frank J. Trelease.

Non-Resident Membership—Fred E. Smith.

Resident Junior—Geo. O. Allain, Jr.

Transfer from Student to Junior Membership—Edwin J. Fisher, Wilhelm E. Koch, Richard B. Kohnke, A. Harold Delbert.

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Annual Meeting of the Society, January 8, 1916.

The meeting was called to order with President Datz in the chair and 55 members and guests present.

The minutes of the last meeting were read and approved.

The annual report of the Board of Direction was submitted and accepted.

The annual report of the Secretary was read, the various statements being omitted.

The annual report of the Library Committee was read and accepted. The report stated that about \$600 had been expended for books and periodicals since October 1, 1914. The statement showed a balance in the Library Fund of \$300.13.

An invitation from the American Society of Mechanical Engineers was read. Our Society is invited to attend the approaching meeting in New Orleans, April 11 to 14, 1916.

A communication from Mr. Robert Glenk was read. Mr. Glenk acknowledged receiving our remembrance.

Ballots for the election of officers for the ensuing year were opened; the following votes were cast:

For President, Samuel Young.....	72
For Vice President, A. T. Dusenbury.....	71
For Treasurer, E. H. Coleman.....	72
For Secretary, W. T. Hogg.....	70
For Director, Rufus S. Manley.....	72

Following the election, Mr. Young was escorted to the chair by Col. Sidney F. Lewis, our first President.

There being no further business, the meeting adjourned to the smoker.

W. T. HOGG, Secretary.

Annual Report of the Board of Direction, January 8, 1916.

To the Louisiana Engineering Society:

Gentlemen—Your Board of Direction begs to report that during the past year it has held 11 regular and 2 special meetings for the transaction of the Society's business.

The reports of the Treasurer and Secretary are attached to this report.

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 Library Committee has done excellent work in collecting a good working library, and has under execution at present improvements to the library room and furnishings which will give to the Society a meeting and study room which will be a pride to the membership. The Library Committee is deserving of the generous thanks of the Society.

The Membership Committee and the members of the Society who cooperated with them are deserving of special praise for their exceptionally good work. Fifty-seven new members were admitted into the Society during the year, which is the largest number for any year in the history of the Society.

The greatest event of the year, and probably in the history of the Society, was the successful launching of our own publication, "Proceedings of the Louisiana Engineering Society." The Publication Committee is deserving of the highest praise for the manner in which they have conducted this great undertaking. Two members of the committee deserve special mention, our honorable Chairman, Mr. L. C. Datz, who first brought the attention of the board and the Society to the possibility of publishing our own Proceedings, and the Editor, Prof. Douglas Anderson, who has turned out each issue a publication that the Society can justly feel proud of.

Attention is called to the excellent showing in the finances of the Society for the year. The Secretary's report shows a balance for the year, after all expenses are paid, of \$378.30, half of which is credited to the Library Fund, \$189.15. Adding balance in General Fund of last year, \$165.60, makes a standing balance in the General Fund of the Society \$354.75. The Treasurer's report shows a balance on hand, January 1, 1916, \$703.11. Collections, January 1 to date, \$326.75. Total cash on hand, \$1,029.86.

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,

SAM'L. YOUNG,

Vice President.

W. T. HOGG, Secretary.

A. T. DUSENBURY,

W. B. GREGORY,

E. H. COLEMAN,

W. H. WILLIAMS.

Annual Report of the Secretary, January 8, 1916.

To the Board of Direction, Louisiana Engineering Society:

Gentlemen—As Secretary of the Society, I beg to submit the following report for the year 1915.

During the year the Board of Direction held 11 regular and 2 special meetings, with an average attendance of 6.7. The Society held 9 regular meetings, with an average attendance of 40, maximum 55, minimum 33.

During the year the membership changed as follows:

GRADE—	On Roll Jan. 9, 1915.	Elected.	Reinstated.	Transferred to	Transferred from	Dropped.	Resigned.	Died.	Failed to Qualify.	On Present Roll.
Resident	96	30	3	5	6	4	6	0	2	117
Non-Resident	48	10	0	7	4	1	2	0	1	56
Associate	9	2	0	0	0	1	0	0	0	10
Non.-Res. Ass.....	1	0	0	0	0	0	0	0	0	1
Junior	17	4	0	1	4	3	0	0	0	15
Non.-Res. Junior....	5	1	0	4	1	0	0	0	0	9
Student	24	10	0	0	2	2	2	0	0	28
Total.....	200	57	3	17	17	11	10	0	3	236

The table shows a total increase in membership of 60, deducting a total loss of 24, leaves a net increase of 36, which is an excellent showing.

Submitted separately is the Treasurer's report, which shows a balance January 1, 1916, of \$703.11. Add to this collections received since January 1, and not yet transferred by Secretary to Treasurer, \$326.75, which makes a total cash on hand of \$1,029.86.

Attached hereto are statements showing the operating results of the General Fund, Proceedings Fund and Library Fund, a Cash Statement showing receipts and expenditures, and a statement of the financial standing of the Society, December 31, 1915.

The following technical exercises were held during the year:

February 8, 1915. A Discussion on the Annual Address of President Williams, entitled "The Ethics of the Contractor."

March 8, 1915. "Forty-four Years with the Levees in Louisiana," by Major Frank M. Kerr.

April 12, 1915. "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," by Mr. William von Phul.

May 10, 1915. "The State Highways of Louisiana," by Mr. Charles M. Kerr.

June 14, 1915. "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 Mr. J. P. Kemper.

September 13, 1915. "Military Engineering," by Mr. A. W. Jackman.

October 11, 1915. A General Discussion on Mr. J. P. Kemper's paper.

November 8, 1915. "The Operation of the Cotton Warehouses," by Mr. F. P. Breckinridge, Manager of the Cotton Warehouses.

December 13, 1915. "Modern Diving and Wrecking Methods on the Mississippi," by Mr. Burris D. Wood.

As Librarian of the 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 an honor and a privilege to serve you, and I thank you.

Respectfully submitted,

W. T. HOGG, Secretary.

Financial Condition of Society, January 1, 1916.

Resources—		
Cash on hand.....	\$ 703.11	
Total due by members.....	350.15	
Total due by Proceedings advertisers.....	76.66	
Total Resources.....	\$1,129.92	\$1,129.92
Liabilities—		
Balances due Proceedings advertisers.....	178.59	
Balance in Proceedings Fund.....	112.20	
Proceedings bills not paid.....	25.00	
Balances due members.....	120.75	
Bills unpaid	38.50	
Balance in Library Fund.....	300.13	
Total Liabilities.....	\$ 775.17	\$ 775.17
Net Balance in General Fund.....		\$ 354.75

Annual Statement for Year 1915.

GENERAL FUND.

Balance from 1914.....\$ 165.60

Revenues—

Dues, membership.....\$1,804.25

Entrance fees, membership..... 313.00

Total Dues and Entrance Fees, 1915..... 2,117.25

Banquet Membership 141.00

Miscellaneous 102.94

Total Revenues, membership.....\$2,361.19 \$2,361.19

Expenses—

Subscription to Proceedings.....\$ 428.34

Library Fund appropriation..... 480.00

Secretary, salary 240.00

Secretary, incidentals 33.55

Printing and stationery..... 286.85

Refreshments, meetings..... 93.50

Banquet Caterers..... 197.30

Profit and Loss, balance..... 58.61

Fines credited to Library Fund..... 6.94

Sales credited to Proceedings..... 78.25

Old Dues (1904) credited to profit and loss 6.50

Badges—\$10.24 credited to Profit and Loss 10.24

1.01 paid to Wm. Frantz & Co.,

credited to Secty. incidentals 1.01

Miscellaneous expenditures..... 61.80

Total Expenses General Fund.....\$1,982.89 \$1,982.89

Operating balance for year 1915.....\$ 378.30

One-half appropriated to Library

Fund..... 189.15

Net Balance.....\$ 189.15 \$ 189.15

Balance in General Fund, January 1, 1916.....\$ 354.75

PROCEEDINGS FUND.

Revenues—

Advertisements\$ 992.41

Subscriptions, membership..... 428.34

Subscription, outsiders (proportion for 1915).....

Sales, membership 78.25

Sales, outsiders 1.75

Total Revenues for 1915.....\$1,500.75 \$1,500.75

Expenses—

Editor, salary	\$ 300.00
Printing Proceedings, Vol. I, Nos. 1, 2, 3, 4, 5, 6.....	916.06
Printing, other items.....	49.45
Stenographer, Society meetings.....	89.25
Engraving	20.00
Incidentals	13.79

Total Expenses for 1915.....\$1,388.55 \$1,388.55

Balance for Year 1915.....\$ 112.20

CASH ACCOUNT.

Cash on hand January 1, 1915.....\$ 50.35

Receipts—

Total Collections, 1914 balances.....	\$ 376.75
Total Collections, 1915 charges.....	2,112.29
Excess credited to Profit and Loss.....	5.00
Exchange on check credited to misc. acct....	.10
Deposit by Secretary credited to Sec'y.	
incident.....	3.00
Total Collections Proceedings advertisers....	1,094.14
Total Collections sales of Proceedings.....	1.75

Total Cash received 1915.....\$3,593.03 \$3,593.03

Less Total Expenditures.....2,938.12

Gross Balance.....\$ 654.91

Deduct Exchange discounts.....3.80

Net Cash Balance for Year 1915\$ 651.11 \$ 651.11

\$ 701.46

Add old check never paid.....1.65

\$ 703.11

Treasurer's Balance, January 1, 1916.....703.11

Add Collections, January 1 to date.....326.75

Total Cash on Hand January 8, 1916.....\$1,029.86

Trial Balances Before and After Closing Ledger for Year 1915.

	—Before Closing—		—After Closing—	
	Dr.	Cr.	Dr.	Cr.
General Fund.....\$		\$ 165.60	\$	\$ 354.75
Banquet acct.....	197.30	141.00		
Profit and Loss acct.....	990.34	21.74		
Proceedings Advertisers.....	992.41	1,094.34	76.66	178.59
Proceedings Fund 1915.....	1,388.55	1,500.75		112.20
Proceedings Fund 1916.....		25.00		25.00
Cash acct.	3,643.38	2,941.92	703.11	
Membership accounts	2,819.94	2,590.54	350.15	120.75
Membership Revenue acct.....	349.94	2,467.19		
Miscellaneous Exp. 1915.....	61.90	.10		
Miscellaneous Exp. 1916.....		17.50		17.50
Secretary Sal. and Inc. acct....	278.26	4.71		
Refreshments, 1915	117.50	24.00		
Refreshments 1916		21.00		21.00
Printing and Stationery acct.	286.85			
Library Fund acct.....	375.96	486.94		300.13
Assn. Engineering Societies....	300.00	300.00		
Totals.....	\$11,802.33	\$11,802.33	\$1,129.92	\$1,129.92

Treasurer's Report.

New Orleans, La., January 8, 1916.

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

Sir—Please find the report of the Treasurer of the Louisiana Engineering Society for the period January 9, 1915, to January 8, 1916:

Balance on hand January 9, 1915.....	\$4.60
Received from Financial Secretary—	
January 18, 1915.....	\$ 349.34
February 3.....	97.25
March 5.....	289.75
March 13.....	290.00
May 5.....	480.00
June 22.....	350.00
August 9.....	479.92
August 29.....	133.25
September 9.....	24.00
September 17.....	9.50
October 2.....	70.75
October 11.....	93.45
October 19.....	108.25
October 26.....	52.00
November 6.....	131.55
November 8.....	95.05
November 20.....	85.65
November 30.....	114.65
December 13.....	218.92
December 28.....	44.50
January 7, 1916.....	121.00
	\$3,638.78
Old check not cashed.....	1.65

Checks issued during this period—

1 Jan. 17, 1915. Assn. Engr. Societies.....	\$ 300.00
2 Jan. 17, 1915. Geo. L. O'Connell.....	20.00
3 Feb. 2, 1915. Kokosky & Co.....	75.43
4 Feb. 2, 1915. F. Daubert	24.00
5 Feb. 2, 1915. W. T. Hogg, Secty.....	23.00
6 Feb. 2, 1915. Electrical World	3.00
7 Feb. 2, 1915. Engr. & Contg.....	2.00
8 Mar. 4, 1915. American Architect	8.00
9 Mar. 4, 1915. Electric Journal	11.00
10 Mar. 4, 1915. Railway Age Gazette.....	5.00
11 Mar. 4, 1915. Int. Engr. Congress.....	30.00
12 Mar. 4, 1915. A. M. Shaw.....	10.00
13 Mar. 4, 1915. Tulane University Press.....	41.70

14	Mar. 4, 1915.	Frank M. Norman.....	18.40
15	Mar. 4, 1915.	John Galatoire	144.30
16	Mar. 4, 1915.	W. T. Hogg, Secty.....	23.25
17	Mar. 12, 1915.	Crescent Cigar Co.....	9.50
18	Mar. 12, 1915.	Searcy & Pfaff, Ltd.....	13.50
19	Mar. 12, 1915.	Engineering Mag. Co.....	3.00
20	Mar. 12, 1915.	F. D. Daubert.....	9.50
21	Mar. 12, 1915.	Power	2.00
22	Apr. 6, 1915.	Tulane University Press.....	29.30
23	Apr. 6, 1915.	Tulane University Press.....	157.00
24	Apr. 6, 1915.	Eugene Dietzgen Co.....	2.70
25	Apr. 6, 1915.	W. T. Hogg, Secty.....	23.05
26	May 4, 1915.	L. C. Datz.....	20.00
27	May 4, 1915.	Samuel Young	7.00
28	May 4, 1915.	James Buckley & Co.....	5.00
29	May 4, 1915.	F. Daubert	10.50
30	May 4, 1915.	Electric Railway Journal.....	3.00
31	May 4, 1915.	Tulane University Press.....	13.25
32	May 4, 1915.	W. T. Hogg, Secty.....	24.80
33	May 24, 1915.	Tulane University Press.....	120.30
34	May 24, 1915.	Searcy & Pfaff.....	47.50
35	May 24, 1915.	Tulane University Press.....	24.10
36	May 24, 1915.	F. Daubert	10.50
37	May 24, 1915.	W. T. Hogg, Secty.....	21.80
38	June 14, 1915.	O. Durel	6.75
39	June 21, 1915.	Tulane University Press.....	18.25
40	June 21, 1915.	The Engineering Magazine.....	3.00
41	June 21, 1915.	Stone & Webster.....	1.00
42	June 21, 1915.	Searcy & Pfaff.....	6.25
43	June 21, 1915.	F. Daubert	10.50
44	June 21, 1915.	W. T. Hogg, Secty.....	23.50
45	June 21, 1915.	Douglas Anderson	150.00
46	Aug. 7, 1915.	O. L. Durel.....	12.50
47	Aug. 7, 1915.	Miss Alice Cooper.....	10.00
48	Aug. 7, 1915.	Am. Soc. for Testing Materials....	29.60
49	Aug. 7, 1915.	Am. Soc. Mun. Imp.....	6.00
50	Aug. 7, 1915.	Am. Inst. Ele. Engrs.....	23.00
51	Aug. 7, 1915.	Am. Ry. Engineering Assn.....	33.50
52	Aug. 7, 1915.	Eugene Dietzgen Co.....	26.90
53	Aug. 7, 1915.	Miss E. Francke.....	5.00
54	Aug. 7, 1915.	F. D. Daubert.....	10.50
55	Aug. 7, 1915.	Tulane University Press.....	33.85
56	Aug. 7, 1915.	W. T. Hogg, Secty.....	26.61
57	Sept. 25, 1915.	Doullut & Williams.....	8.59
58	Sept. 25, 1915.	J. Klorer	10.00
59	Sept. 25, 1915.	Industrial Engineering	2.00

62 *Proceedings of the Louisiana Engineering Society*

60	Sept. 25, 1915.	Am. Soc. Mun. Impts.....	2.00	
61	Sept. 25, 1915.	Miss Carrie S. Freret.....	15.00	
62	Sept. 25, 1915.	Tulane University Press.....	361.36	
63	Sept. 25, 1915.	W. T. Hogg, Secty.....	44.38	
64	Nov. 15, 1915.	Jas. Buckley & Co.....	5.00	
65	Nov. 15, 1915.	Frank N. Norman.....	5.20	
66	Nov. 15, 1915.	M. Clay LeJeune.....	25.00	
67	Nov. 15, 1915.	Searcy & Pfaff.....	22.50	
68	Nov. 15, 1915.	A. Daubert	21.00	
69	Nov. 15, 1915.	Tulane University Press.....	73.85	
70	Nov. 15, 1915.	Tulane University Press.....	162.60	
71	Nov. 15, 1915.	W. T. Hogg, Secty.....	44.95	
72	Nov. 15, 1915.	Engineering News	3.00	
73	Dec. 20, 1915.	Tulane University Press.....	19.25	
74	Dec. 20, 1915.	Tulane University Press.....	197.55	
75	Dec. 20, 1915	Dameron-Pierson Co.	6.75	
76	Dec. 20, 1915.	Douglas Anderson	150.00	
77	Dec. 20, 1915.	W. T. Hogg, Secty.....	25.05	
		Exchange	3.80	
			\$2,941.92	\$3,645.03
Balance on hand January 7, 1916.....			703.11	
			\$3,645.03	\$3,645.03

Respectfully submitted,

E. H. COLEMAN, Treasurer.

Report of Library Committee.

New Orleans, La., January 8, 1916.

To the President and Members of Louisiana Engineering Society:

Gentlemen—Your Library Committee desires to submit the following report for the year ending December 31, 1915:

Perhaps the most important additions to the library during 1915 were "Proceedings" of American Railway Engineering Association, American Institute of Electrical Engineers, American Society for Testing Materials, and American Society of Municipal Improvements—all of these from 1910 to date. However, a number of other valuable books were added during the year.

The expenditures for the library during the year are shown in the following statement prepared by the Secretary:

Debits—

1915.		
Feb. 2.	Kokosky & Co.....	\$ 75.43
Mar. 4.	American Architect	8.00
Mar. 4.	Electrical Journal	11.00
Mar. 4.	Ry. Age Gazette.....	5.00
Mar. 4.	International Eng. Cong.....	30.00
Mar. 12.	Engineering Index	3.00
Mar. 12.	Power	2.00
Apr. 6.	Eugene Dietzgen Co.....	2.70
May 4.	Electric Ry. Journal.....	3.00
May 24.	Searcy & Pfaff.....	47.50
June 21.	Eng. Magazine	3.00
June 21.	Stone & Webster Jour.....	1.00
June 21.	Searcy & Pfaff.....	6.25
Aug. 7.	Am. Soc. Test. Mat.....	29.60
Aug. 7.	Am. Soc. Munic. Imp.....	6.00
Aug. 7.	Am. Inst. Elect. Engrs.....	23.00
Aug. 7.	Am. Ry. Eng. Assn.....	33.50
Aug. 7.	Eugene Dietzgen Co.....	26.90
Aug. 7.	Tulane Press	1.50
Sept. 25.	Industrial Engn.....	2.00
Sept. 25.	Am. Soc. Munic. Imp.....	2.00
Sept. 25.	Carrie S. Freret.....	15.00
Sept. 25.	Two cuspidors	1.38
Sept. 25.	Tulane University Press.....	3.75
Nov. 15.	Searcy & Pfaff.....	22.50
Nov. 15.	Tulane University Press.....	1.50
Nov. 15.	Carnegie Index	.75
Nov. 15.	Engineering News	3.00
Nov. 15.	Eng. Contracting	2.00
Nov. 15.	Electrical World	3.00
Nov. 15.	Incidentals	.70
		\$ 375.96
Dec. 31.	Balance in Library Fund.....	300.13
		\$ 676.09

Credits—

1915.

Jan. 1. L. H. Guerin.....\$ 3.34

Fines—

Aug. 10......80

Aug. 18......40

Sept. 30.....1.00

Oct. 21......30

Nov. 18......20

Dec. 1590

Rent Appropriation for 1915 at \$40.00 per month..... 480.00

\$ 486.94

One-half Operating Balance of 1915..... 189.15

\$ 676.09

We might mention that, since October 1, 1914, there has been expended about \$600.00 for books and periodicals, and we feel that the Society now has a fairly good working library for most engineering problems. However, we realize that there are many other books which the library should have, and no doubt these will be purchased as funds are available.

The improvements which are to be made to the library room and bookcases are already under way, and we hope that by the time of the February meeting, the library will be available as a meeting place.

When the new book cases are completed, the books should be placed in them so as to be readily accessible as to subjects, etc. It will no doubt be possible to have this done by Miss Freret or some other young lady who is familiar with the care of libraries. In fact, we believe that such service, for keeping the books in order, may be obtained by the year at a very reasonable rate of compensation. We believe that this question should be taken up as soon as the bookcases are ready for use.

In conclusion, we urgently request the entire membership of the Society to co-operate with the Library Committee by suggesting books which should be in the library but which have not yet been acquired.

We are glad to report that some very good books are being acquired through the medium of our journal, they being sent to the Editor to be reviewed.

Respectfully submitted,

SAM'L YOUNG,

R. S. MANLEY,

LEO. S. WEIL,

Library Committee.

The Proceedings of the Louisiana Engineering Society

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

DOUGLAS ANDERSON, Editor.

The Louisiana Engineering Society is not responsible for any
statement made or opinion expressed in this publication.

Subscription, \$2.00 per annum

Single copy, 35 cents

ADVERTISING RATES

	ONE YEAR	HALF YEAR	ONE ISSUE
Full page	\$50.00	\$28.00	\$10.00
Half-page	28.00	15.00	6.00
Quarter-page	15.00	10.00	4 00
One-eighth page	10.00	6.00	2.00

For the back outside cover add 50 per cent to the above
rates. For the inside covers add 25 per cent to the above
rates.

Address all communications to
Douglas Anderson, Editor, Tulane University,
New Orleans, La.

LOUISIANA ENGINEERING SOCIETY

OFFICERS FOR 1916

President, SAMUEL YOUNG, 1002 Perrin Building.
Vice-President, A. T. DUSENBURY, 236 Baronne Street.
Secretary, W. T. HOGG, Tulane University.
Treasurer, E. H. COLEMAN, 920 Hibernia Building.

DIRECTORS.

W. B. GREGORY, Tulane University.
OLE K. OLSEN, 822 Perdido Street.
L. C. DATZ, United Gas & Electric Eng. Corporation,
Birmingham, Ala.
R. S. MANLEY, 301 Q. & C. Building.

STANDING COMMITTEES

On Technical Papers

W. B. Gregory
A. M. Lockett
Wm. von Phul

On Library

A. M. Shaw
E. H. Coleman
B. S. Nelson

On Publications—Division "A"

Douglas Anderson
J. M. Robert
W. T. Hogg

On Publications—Division "B"

W. H. Williams
A. T. Dusenbury
R. B. Quincy
John Riess
G. A. Seaver

On Membership—Division "A"

R. S. Manley
James S. Sharp
G. W. Lawes
H. E. Crump

On Membership—Divison "B"

Ole K. Olsen
Chas. M. Kerr
L. H. Guerin
Alfred Raymond
T. L. Willis

On Employment

H. Kokosky
Chas. J. Hardy

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

All business communications should be addressed to W. T. Hogg, Secretary,
P. O. Station 20, New Orleans, La.



LOUISIANA STATE MUSEUM, HEADQUARTERS OF THE LOUISIANA ENGINEERING SOCIETY

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. II

APRIL, 1916

NO. 2

CONTENTS

FRONTISPIECE :

EDITORIAL NOTES AND COMMENT :

	PAGE
Structural Features of the Cotton Warehouses	65
The New Library Room	66
Spring Meeting of the A. S. M. E.	67
A "Freak" of the High Water	70
Nelson Valve Company	71
Military Information for Civilian Engineers	72
New Members	72
Our Advertisers	73

PAPERS AND DISCUSSION :

Some Structural Features of the Cotton Warehouses and Terminals of the Board of Commissioners of the Port of New Orleans. <i>By</i> <i>Frank J. Trelease</i>	74
Discussion	105
Our New Quarters. <i>By J. M. Robert</i>	117
Specifications for Wooden Piles. <i>By E. P. Goodrich and Samuel</i> <i>Young</i>	120

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY	124
---	-----

EDITORIAL NOTES AND COMMENT

Structural Features of the Cotton Warehouses.—One of the most extensive and important engineering enterprises undertaken in New Orleans in recent years is the construction of the Cotton Warehouses and Terminals. There have already been published in this journal two papers dealing with this undertaking, one by Mr. Wm. von Phul, of the firm of Ford, Bacon & Davis, dealing with the Economic Features Controlling the Design of the Warehouses, and the other by Mr. F. P. Breckenridge on the Operating Features of the Warehouses. The paper by Mr. F. J. Trelease, of Ford, Bacon & Davis, read before the Society at its

February meeting, and published in this issue of the *Proceedings*, deals with the Structural Features of the various buildings, and is a most interesting and valuable contribution to the problem of structural design in reinforced concrete.

In the introduction Mr. Trelease discusses the relative advantages and disadvantages of the different types of wall construction which were considered in the original plans. Reinforced concrete construction throughout was adopted, the specific advantages of which were most satisfactory fire-proof qualities, greatest structural strength, and least cost. As a guide for the determination of the details of the design the recommendations of "The Joint Committee on Concrete and Reinforced Concrete" were adopted. The "ribbed slab" type of design was adopted for the roof both on account of its greater economy, and from the fact that it would lend itself well to the use of steel forms in the course of construction. The design of the crane shelf is of special interest in that it differs from the ordinary or usual type in which the crane shelf is carried on brackets either of steel or of reinforced concrete, the crane rail being carried in this design on a continuous bracket supported throughout its length by the 12" fire wall.

The floors and roof of the wharf house are of the flat slab type of reinforced concrete construction, and a very considerable portion of the paper is given over to a discussion of the details of design and construction used in connection with this type. A brief description, with diagrams and cuts of the apparatus used, is given of some experimental work done by Mr. Trelease in 1912 in which an attempt was made to secure some experimental data upon the stresses and deformation in a flat plate subjected to the same sort of forces that come into play with the flat slab of concrete. These experiments were made upon a plate of rubber as a model test plate, and as pointed out by Mr. Trelease, the data there obtained are in quite reasonable agreement with the results of some tests made in 1914 by Mr. Slater upon an actual reinforced concrete structure.

The New Library Room.—At the regular meeting of the Society, March 13, the new library room was used for the first

time since its completion. Under the plans of Mr. Churchill the old room has been remodelled to make it more convenient for the purposes of the Society, while at the same time preserving the more attractive features of its original architecture. At present the walls and cases are all in white, the intention, however, being to paper or tint the walls, this portion of the work having been delayed on account of the effects of the September storm. At that time the building was partially unroofed and the walls were completely soaked with water. They are of such great thickness that they are slow in drying out, and it was thought wiser to wait for a time before doing any further work upon this feature of the decoration. Thanks to the efficient and unremitting personal efforts of President Young and of Mr. Shaw, Chairman of the Library Committee, the books have been placed upon the shelves, and now only await some systematic scheme of cataloging and arrangement. The room is well lighted with semi-indirect units, and the whole effect is quite pleasing.

Special mention should be made of the fact that the very handsome pine flooring was presented to the Society by the Southern Pine Association, through the courtesy of Mr. E. J. Rhodes, Secretary of the Association. Every piece of lumber was specially selected for this floor, and almost everyone who has seen it has remarked upon the very excellent quality of the material and the beauty of the floor.

Further special mention must be made of the generosity of Mr. John Riess, prominent contractor and member of the Society, who did all the work of remodelling the room at actual cost and without any profit to himself.

These are instances of the spirit of coöperation which seems to pervade the membership of this Society and which constitutes the best augury for its continued welfare and prosperity.

Elsewhere in this number will be found an article by Mr. Jas. M. Robert, dealing with some of the more interesting points in the history of the building, in which are located our new headquarters.

Spring Meeting of the A. S. M. E.—The Spring Meeting of the American Society of Mechanical Engineers will be held this

year in New Orleans, April 11-14. The Louisiana Engineering Society is to be joint host along with the local chapters of the Mechanical Engineers and the Civil Engineers to the delegates and guests who will attend the convention. Prof. William B. Gregory and Mr. Henry L. Hutson are Chairman and Secretary, respectively, of the local Committee of Arrangements. At this writing the tentative program has been agreed upon as follows:

TUESDAY, APRIL 11.

Afternoon—Registration.

Evening—Informal reception.

WEDNESDAY, APRIL 12.

Morning—Business meeting, followed by professional session on "Organizing for Industrial Preparedness." Particular attention is called to this session and a general discussion by the membership, either oral or written, is solicited.

Afternoon—Trip on the river, which will also give an opportunity to view the harbor as a whole and inspect the new cotton warehouse and other features of interest.

Evening—Address by W. B. Thompson, Esq., Commissioner of Public Utilities of the City of New Orleans.

THURSDAY, APRIL 13.

Morning—Professional session with papers on engineering problems of the South.

Afternoon—Entertainment at Country Club. Tea at Newcomb Pottery, 5 o'clock.

Evening—Reception and dance.

FRIDAY, APRIL 14.

Morning—Simultaneous professional sessions: one on "Measurement of the Flow of Fluids;" and one with miscellaneous papers, including a topical discussion on "The Utilization of Texas Fuels."

Afternoon—Excursion to reclaimed lands near New Orleans.

The papers listed below will be presented at this meeting:

For Presentation Wednesday Morning, April 12:

ORGANIZING FOR INDUSTRIAL PREPAREDNESS, Spencer Miller, Member of Council, Am. Soc. M. E., Member Naval Consulting Board.

For Presentation Thursday Morning, April 13:

CAPACITY AND ECONOMY OF MULTIPLE EVAPORATORS, E. W. Kerr, Member Am. Soc. M. E.

THE EVOLUTION OF LOW LIFT PUMPING PLANTS IN THE GULF COAST COUNTRY, William B. Gregory, Member Am. Soc. M. E.

MECHANICAL EQUIPMENT USED IN THE PORT OF NEW ORLEANS, William von Phul, Member Am. Soc. M. E.

For Presentation Friday Morning, April 14:

ESTABLISHING A STANDARD OF MEASUREMENT FOR NATURAL GAS IN LARGE QUANTITIES, Francis P. Fisher, Member Am. Soc. M. E.

DEVIATION OF NATURAL GAS FROM BOYLE'S LAW, Robert F. Earhart and Samuel S. Wyer, Members Am. Soc. M. E.

SOME EXPERIMENTS ON WATER-FLOW THROUGH PIPE ORIFICES, Horace Judd, Member Am. Soc. M. E.

THE MEASUREMENT OF VISCOSITY AND A NEW FORM OF VISCOSIMETER, H. C. Hayes and G. W. Lewis.

DYNAMIC BALANCE, N. W. Akimoff.

DISASTROUS EXPERIENCES WITH LARGE CENTER-CRANK SHAFTS, Louis Illmer, Member Am. Soc. M. E. (Contributed by the Gas Power Committee.)

ON THE TRANSMISSION OF HEAT IN BOILERS, E. R. Hedrick and E. A. Fessenden, Member Am. Soc. M. E.

Attention is called to the fact that three of these papers are by local men, who are also members of the Louisiana Engineering Society.

The Committee on Arrangements is specially anxious to have the members of this Society coöperate with them in the matter of enabling the visiting engineers and their wives to see as many of the interesting features of the city as possible. With this end in view it is planned to secure permission for them to visit industrial plants, and to make a list of these plants as well as of the various points of interest to the tourist, so that each visitor upon

arrival and registration may signify the trips which they would desire to take. In order to carry out this plan efficiently co-operation of the members of this Society is desired in the line of acting as guides for different parties, and also in furnishing, where possible, automobiles for the purpose. It is also suggested that our members, such as may conveniently be able to do so, spend as much time as possible about the official headquarters in the Grunewald Hotel in order to get acquainted with the visitors and to help make them feel at home. Particular attention is called to the informal Tuesday evening reception as a "get acquainted" meeting.

A "Freak" of the High Water.

(The Editor is in receipt of the following letter from Mr. Henry L. Hutson, enclosing therewith a clipping from *The Times-Picayune*, in which were shown a number of views from the flood-stricken section. One of these views shows what the paper calls a "freakish occurrence on a farm a short distance back of the levee." It is simply an ordinary pitcher pump through which the water is flowing steadily.)

NEW ORLEANS, February 22, 1916.

Prof. Douglas Anderson, Editor, Proceedings Louisiana Engineering Society:

RE PREVENTION OF "BLOWOUTS" IN LEVEES.

DEAR SIR—The enclosed picture, which appeared on the front page of *The Times-Picayune* this morning, showing water flowing from a pitcher pump on a surface well, illustrates better than any written description could the condition which the levee engineers have to contend with in many places. It is very evident that there is a stratum of sand, not more than 20 feet below the surface, which connects with the river. It is these porous strata which cause "sand boils" and "blow outs." In other words, their problem is to build many miles of earthen dams on porous foundations, and this without the necessary funds to first secure safe foundations.

This "artesian" head, which shows itself by causing a strong flow several feet above the ground, is, of course, a serious menace to the safety of the levee, and it is to suggest a means of reducing this pressure that I am writing.

Of course, the most natural suggestion, and, I have no doubt, the proper remedy, would be to drive sheet piling below the levee, but the first cost has no doubt prevented its extended use.

My suggestion is to try and relieve this pressure by driving a number of wells at a safe distance in the rear of the levee. This may seem to some an altogether impracticable suggestion, and it may be for what I know, as I have no intimate knowledge of the conditions, and can readily see that it might fail through insufficiency. Nevertheless, I should like to see some experiments along this line. In the case of flows from artesian strata it takes only a limited number of wells to reduce the head until the wells no longer flow and have to be pumped. This has happened in New Orleans and many other places along the coast.

The use of well points to reduce water pressure in quicksand during construction work is recognized practice. I should think they might well be used as a permanent auxiliary to an earth dam where the funds were insufficient to install sheet piling.

There may also be cases where the flow of the ground water is towards the river, and where it would be desirable to relieve the pressure in order to keep the base of the levee dry, even when the sheet piling is used. The pipes would then serve the same function in the ground that the seep ditches do in the surface of the levee.

Yours truly,

H. L. HUTSON.

Nelson Valve Company—It gives us pleasure to call attention to the fact that one of our advertisers, The Nelson Valve Company of Philadelphia, has recently secured the services of Mr. E. A. Hamilton as Assistant Manager of Sales, former manager of Philadelphia branch of the C. A. Dunham Co., Marshalltown, Iowa, manufacturers of Vapor Heating Systems. Mr. Hamilton will have special charge of Advertising, Sales Promotion, and assuring all Nelson customers of prompt and satisfactory service.

Military Information for Civilian Engineers—Major Caples, of the local U. S. Engineers' office, has recently sent to the Secretary of the Society a pamphlet issued by the U. S. War Department, Office of the Chief Engineer, which gives a list of books and articles on the subject of military engineering and allied topics, from which the civilian engineer would be able most readily to obtain information along these lines. We are glad to call attention to this list and to state that it is available to any members of the Society upon application to the Secretary. Such a list has a timely importance in these days when the engineer, along with other leaders in industrial pursuits, must turn his attention to the important question of "preparedness."

New Members.—The Secretary has submitted the following list of new members and of transfers of membership:

RESIDENT MEMBERS.

Robert M. O'Brien, 5315 Camp street, city.

Frank J. Trelease, 912 Fern street, city.

NON-RESIDENT MEMBERS.

Fred E. Smith, P. O. Box 146, Baton Rouge, La.

RESIDENT JUNIOR MEMBER.

Geo. O. Allain, Jr., 6214 St. Charles avenue, city.

TRANSFER FROM STUDENT TO RESIDENT JUNIOR MEMBER.

A Harold Delbert, 4730 Prytania street, city.

Ralph Earl, 1419 Henry Clay avenue, city.

Edwin J. Fisher, 2316 Camp street, city.
Wilhelm E. Koch, 2627 Coliseum street, city.
Richard B. Kohnke, 2506 Berlin street, city.

Our Advertisers—When you read this number of the *Proceedings*, do not forget to turn over to the Advertising Section. There you will find some twenty-five or more pages of very interesting reading. And when you read it keep in mind the sentiment "Patronize our Advertisers." The publication of this journal would be practically impossible were it not for the assistance rendered us by the firms and individuals who use the journal as an advertising medium. And if it is a question of where to place an order for material or machinery, or whom to employ as consulting engineer on a certain job, all other things being equal, the order or the job should go to those who help us with this enterprise.

PAPERS AND DISCUSSIONS

SOME STRUCTURAL FEATURES OF THE COTTON WARE- HOUSES AND TERMINALS OF THE BOARD OF COM- MISSIONERS OF THE PORT OF NEW ORLEANS.

By

FRANK J. TRELEASE.

Engineer With Ford, Bacon & Davis.

Read before the Society February 14, 1916.

The New Orleans Cotton Warehouse and Terminal plant is structurally a large reinforced concrete project. You are all, no doubt, more or less familiar with the appearance and arrangement of the buildings comprising the plant. In the completed Plant there will be six large, single story warehouses, a compress building and a two-story wharf house, all connected by a system of overhead runways or bridges. In addition to these main buildings, there will be a two-story power house and a three-story office building, as well as numerous small transformer and machinery houses.

In the design of this large plant, which involves over a hundred thousand cubic yards of concrete and some twelve million pounds of reinforcing steel, many interesting problems were encountered, and it is the purpose of this paper to give an account of a few of them.

The first of these was the selection of the most suitable building materials. A preliminary study indicated that the choice lay between brick and steel structures and structures of reinforced concrete. After a careful study of the relative merits of various building materials, reinforced concrete was adopted and has been used in the construction of the entire plant. Each type of structure, required a special study.

For the runways it would have been impossible to use brick and steel, except in the form of a steel supporting structure carrying a floor of brick arches, and for the runways, therefore, there was no doubt that reinforced concrete was the more suitable and economical material.

The selection of materials for the warehouses required a more careful study. The necessity for constructing the buildings in the most fire proof manner limited closely the choice of materials for construction, and the selection of materials was influenced also by the uncertain nature and cost of the foundations.

Of the fire proof materials available, the one first considered was brick. It was found that brick bearing walls would not be suitable, both because of their excessive cost due largely to the great thickness required and the cost of the foundations for supporting this weight, and also because they would be poorly adapted to resist eccentric loads caused by the cranes and lateral loads due to piles of cotton stacked against them, or to the swelling of cotton if saturated in case of fire.

From these considerations, it seemed desirable to use a skeleton form of construction. The choice of the material for the skeleton was necessarily between structural steel and reinforced concrete. Of these materials the reinforced concrete was found to be considerably less costly, partly on account of the necessity for a fire proof covering over structural steel, if used. For these reasons, it was decided to adopt as the general type of building, a reinforced concrete frame work, and a study was then made to ascertain the best type of material to be used for the enclosing and dividing walls.

For this purpose hollow tile, brick and reinforced concrete were considered. The hollow tile was thought desirable on account of its light weight, small cost and apparently fire proof qualities. A discussion with the Underwriters' representatives resulted in their refusal to consider the use of any form of tiling for the walls of the warehouses, and it developed in this discussion that the walls forming the divisions between the several compartments of the building were considered by the Underwriters to be of the utmost importance, on account of limiting the amount of loss should a fire develop in any compartment. The Underwriters indicated that walls of brick or concrete would be required.

A careful comparison was then made between these materials, consideration being given to all characteristics affecting fire

hazards, structural strength, permanence and appearance, speed of construction, general desirability and cost.

Estimates showed that any satisfactory type of brick wall would be more expensive than a much more desirable type of reinforced concrete wall. This was partly due to the requirements of the Underwriters that a brick wall be at least 50% thicker than a reinforced concrete wall under the same conditions, which requirement seems entirely reasonable in view of recent experience with reinforced concrete structures which have been subjected to severe fires.

The advantage of reinforced concrete for use in the walls was further increased by the reduction in weight of the walls, permitting less costly foundations. Because of the foregoing considerations it was decided to use reinforced concrete for all parts of the structure.

In a study of the design of the buildings, it became apparent that a very great increase in structural strength could be secured without additional cost by distributing the reinforcing material through the walls instead of concentrating it in the skeleton, thus securing a much better distribution of the steel and a better distribution of the load on the foundations.

The final design adopted for the warehouses was in reality a combination of a skeleton and a bearing wall design, and provided for a building of unusual structural strength, and particularly well suited to the soil conditions where the bearing power at particular points was extremely uncertain, although the general supporting power was quite satisfactory.

The points of special influence in the adoption of the reinforced concrete for the buildings, included, as mentioned above, most satisfactory fire proof qualities, greatest structural strength, and least cost. In addition to these the decision was influenced by the convenience of construction, the ability to construct without skilled workmen and the consequent greater freedom from labor troubles, and the greater advantage in a business way resulting from the general sentiment of confidence in reinforced concrete as the most modern and up-to-date building material.

Having determined upon reinforced concrete as the best and most satisfactory building material, special studies were made

for each type of building to determine the particular design which would be most satisfactory. Certain principles, however, were common to all of the structures.

Reinforced concrete has long since passed the experimental stage and for a number of years certain principles have been regarded as essential to good practice. These principles are for the most part summarized in the report of "The Joint Committee on Concrete and Reinforced Concrete," and the recommendations of this report were therefore adopted as a guide in determining the details of the designs.

The work was of such character as to require a 1 : 2 : 4 Portland Cement concrete. For such a concrete the Joint Committee Report recommends working stresses as follows :

<i>Direct compression</i>	450lb per square inch.
<i>Extreme fibre stress in bending</i>	650lb per square inch.
except at the supports of continuous beams or slabs where the stress may be.....	750lb per square inch.
<i>Shear involving diagonal tension</i>	40lb per square inch
unless special reinforcement is installed to resist the diagonal tension, in which case the shear shall not exceed	120lb per square inch.

The bond between the concrete and steel was taken at 120 pounds per square inch of contact.

The modulus of elasticity of the concrete was taken at 2,000,000.

The Joint Committee Report does not specify stresses for long columns but for such columns the stress was reduced in proportion to the ratio between the least side of the column in inches divided by the unsupported length in feet.

Deformed steel bars were used for reinforcement, being stressed to 16,000 pounds per square inch in tension, except that temperature reinforcement was computed on the basis of 50,000 pounds per square inch minimum elastic limit.

The specification for the reinforcing steel stipulated that it conform to the requirements of the Standard Specifications for Steel Reinforcing Bars of the American Society for Testing Material of latest date. Bars of hard grade steel were used wherever they could be placed without bending. Because of the possibility of fracturing hard grade bars in the process of bend-

ing and consequent delay, all bars which were to be bent were of structural steel grade.

The report of the Joint Committee states that in general the reinforcement for the distribution of temperature and shrinkage stresses should not be less in amount than $\frac{1}{3}$ of 1% of the concrete in which it is placed. Inspection of various plans for reinforced concrete structures and of text-books on reinforced concrete designs, shows that in various instances steel amounting to from about $\frac{1}{10}$ of 1% to about $\frac{1}{2}$ of 1% has been provided or recommended for this purpose. The lack of definite recommendations covering the amount of reinforcement necessary and the lack of agreement in the amounts, as used or recommended by different designers and authorities, indicated the desirability of independent consideration of the problem.

If a structure of concrete is subjected to a fall in temperature, it will contract in length. The coefficient of expansion or contraction for concrete is 0.0000055 and assuming a modulus of elasticity of 2,000,000, it is evident that if the concrete is fixed at the ends or is of sufficient length to act as though fixed at the ends, as is usually the case, a fall of temperature of 1° Fah. will cause a unit tensile stress in the concrete of 11 pounds per square inch. Assuming an ultimate tensile strength of 200 pounds per square inch, the concrete would crack if subjected to a fall in temperature of only about 20°.

Since considerably more than 20° variation in the temperature is to be expected, the need of temperature reinforcement for structures of concrete is apparent. After a structure of unreinforced concrete has been subjected to a fall of 20° thus causing one or more cracks to form, a further fall in temperature will cause these cracks to increase in size to such a degree that they are not only very unsightly but may seriously affect the strength of the structure. No amount of temperature reinforcement will alter the coefficient of expansion of the structure, since the coefficients of expansion of steel and concrete are practically the same. Therefore enough reinforcement must be provided to distribute the change in length of the structure due to temperature amongst a large number of cracks each of which will be very small.

The amount of steel necessary to do this is such that its strength will equal the tensile strength of the concrete. With this amount of steel, in case a small crack is formed at one place, there will be enough reinforcement passing through this crack to prevent its opening up and enough steel to rupture the structure at other places, thus causing a multitude of small cracks, instead of a few large ones.

Assuming concrete with an ultimate tensile strength of 200 pounds per square inch and reinforcing steel with an elastic limit of 50,000 to 55,000 pounds per square inch, it follows that reinforcement equalling at least $4/10$ of 1% of the area of the concrete in which it is imbedded must be provided in order to satisfactorily distribute temperature strains.

Special features of interest in the design of the various types of structures will now be discussed.

The design of the warehouses was controlled largely by the dimensions of the site available,—the manner of storing the cotton, the Underwriters' requirements and structural economy. The over all dimensions of the various warehouse buildings were determined to a great extent by the dimension of the site available and by the general arrangement of the buildings which had to be maintained for the satisfactory operation of the plant.

These factors limited the width of the buildings to approximately 275 feet, including the platforms. It was desired that the upper platforms or balconies be wide enough to permit of ranging and sampling cotton without interferenig with the passage of trucks in each direction. In order that cotton could be handled by the cranes from the lower platform to the upper platform, or to the interior of the buildings, it was necessary that the lower platform project beyond the upper.

Two of the warehouses are each 203 feet wide, exclusive of the platforms, and 420 feet long, and two are of the same width but each 580 feet long. A two-story covered platform is provided along each side, the first floor platform being 35' wide and the upper floor 25', offering ample room for ranging and sampling as well as for trucking from building to building.

The warehouses are divided into compartments, each 32 feet wide and a little over 100 feet long, and have a clear story height

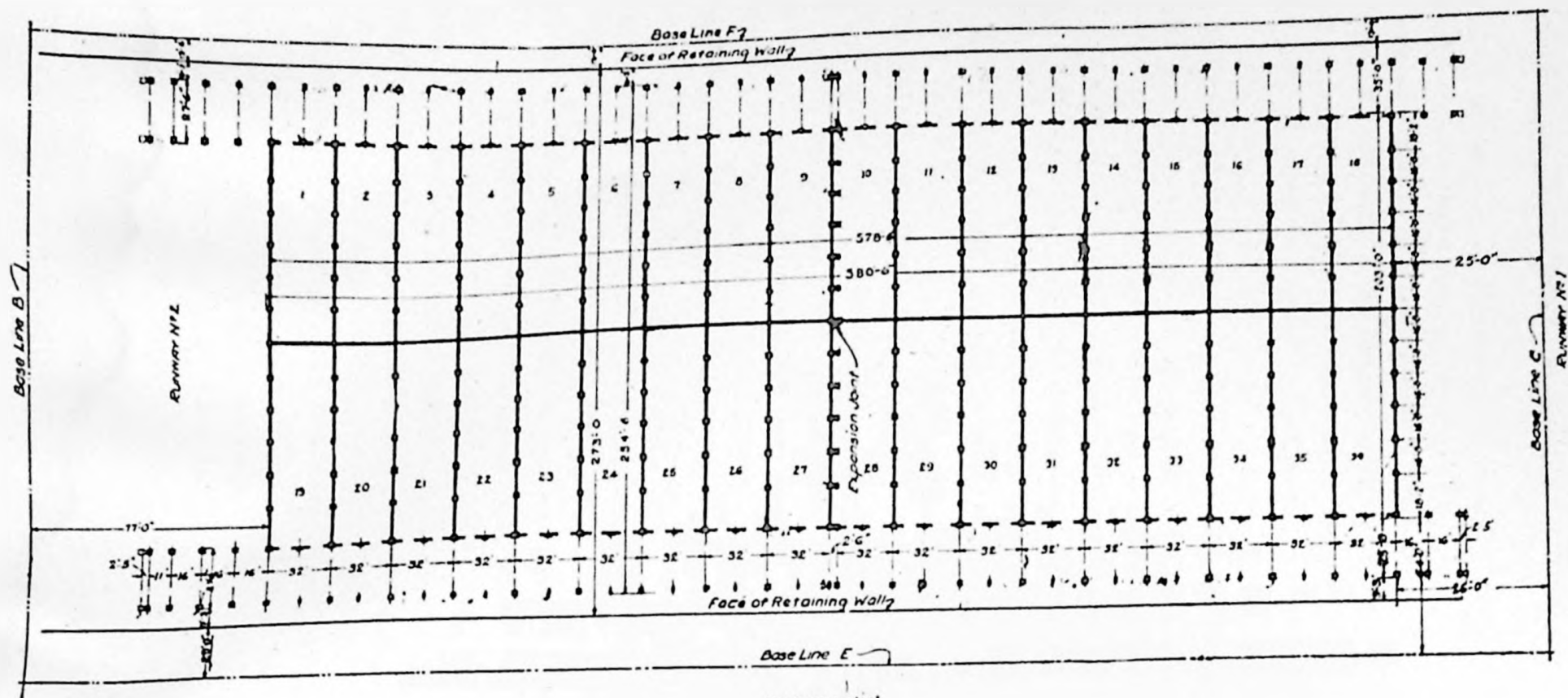


Fig 1.

of about 36 feet. The walls forming the compartments are of reinforced concrete 12 inches thick and near the top of each is a reinforced concrete shelf upon which are bolted the steel crane rails. Steel crane girders extend out from each compartment over the platforms so that the cotton may be handled by the cranes from either the upper or lower platform directly into the warehouses or vice versa.

Figure 1 is a key plan of one of the warehouses and shows the arrangement of the fire walls and of the columns supporting the upper platform or balcony.

The spacing of the fire walls was determined partly by the manner of storing the cotton which had been decided upon and partly by the Underwriters' requirements. It had been decided to store the cotton in tiers ten or more bales high. It was necessary that one end of each bale be on an aisle. This manner of storing required a building with the clear width of the compartments some multiple of 15 feet. Studies were made of the comparative cost of buildings having fire walls spaced 17, 32 and 47 feet centers, an allowance of two feet for the wall construction having been made. It was found that the 32 foot spacing was the most satisfactory especially on account of the considerations affecting the insurance.

With compartments 32 feet wide and 110 feet long the capacity was nearly 2,000 bales, forming a total risk on the cotton of approximately \$100,000, which was as large as it was desirable to handle.

Having determined the width of the compartments the most economical design of roof construction was considered. Studies were made of two types of construction, one being what may be called a "ribbed slab" design, in which the entire roof was formed by T beams placed side by side, and the other the usual beam girder type.

Careful cost comparisons showed the ribbed slab type to be the most economical and as it was a type well adapted to the use of steel forms, it was adopted, since it was felt that a further saving might be possible in case those were used.

Having determined upon the ribbed slab type of roof, studies were made to determine the most economical depth and spacing

of the ribs. The cost of the walls was taken into account and was found to be quite an important item. The head room was extremely limited in the buildings and the use of deep ribs meant additional height of the structure and consequent increased cost, which must be deducted from any apparent saving in reinforcement due to the use of the deep rib.

Cost studies showed that a rib spacing of about 4 feet and a depth of from 18" to 24" would be most economical. Adjustment of the rib depth was then made to suit the commercial sizes of the reinforcing bars, leading to the adoption of ribs 20" deep. These ribs were six inches wide and were spaced four feet two inches center to center and carried a three-inch roof slab.

Figure 2 is a plan of a portion of one of the warehouse roofs, while Figure 3 gives details of the ribs.

The minimum thickness of the fire walls was fixed by the insurance requirements at 12". The thickness of wall was investigated for strength and after the addition of pilasters was found to be satisfactory. The fire walls, beside acting as fire stops or barriers, needed to be structurally sufficient to carry the dead and live loads of the roof and the eccentric loads due to the cranes as well as any lateral pressure which might be exerted by cotton piled against them or by the swelling of cotton saturated in case of fire.

Temperature reinforcement amounting to $\frac{4}{10}$ of 1% of the area of the concrete was provided horizontally in the fire walls and vertical reinforcement of one-half this amount.

Figure 4 gives details of the fire walls.

The 12-inch walls with this reinforcement were then investigated and it was found that they had sufficient strength when assisted by the pilasters to resist any lateral pressures due to the cotton and also the moments due to eccentric loading of the cranes when these moments were distributed over a reasonable distance by the crane shelf.

Pilasters 24" square were provided at intervals of 16'8". These pilasters contained sufficient reinforcement to enable them to develop the full strength of the concrete in case they were called upon to act as stiffeners and prevent buckling of the walls. This amount of reinforcement was also sufficient to take care of

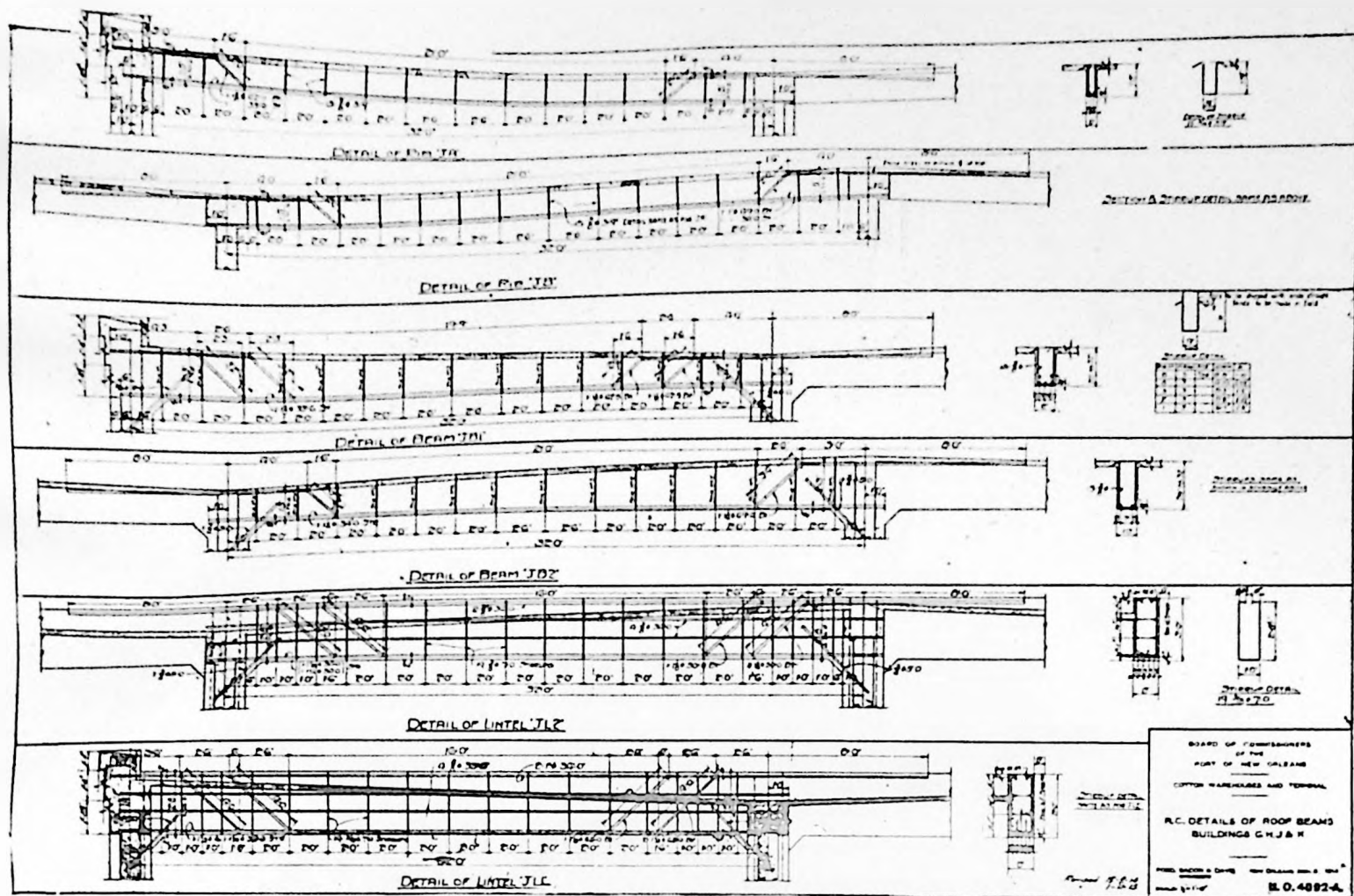


Fig. 3.

the entire eccentric loading of the cranes which might be concentrated at the pilasters because of the great stiffness of the pilasters, and to take care of lateral pressure due to cotton stacked against the walls. The pilasters also had sufficient reserve strength below the elastic limit of the steel to resist lateral pressure which might be exerted by any swelling of the cotton if saturated in case of fire.

The crane shelf design is of particular interest because it is somewhat unusual. Comparative cost studies were made for steel crane girders of the usual design supported on brackets at the pilasters and for reinforced concrete crane girders similarly supported. A third design was investigated in which the crane rail was carried on a continuous bracket or shelf supported throughout its length by the 12" fire wall. This design was found to be more economical than either the steel or concrete girder and in addition to its low cost had many advantages.

It acted as a large distributing beam, spreading the crane loads along a considerable length of wall, and was also well adapted to resist any local tendency for lateral deflection of the wall and to resist lateral thrust caused by sudden starting or stopping of the crane trolley. This type of crane shelf was therefore adopted.

The end walls of the building are similar in design to the fire walls, except that sufficient reinforcement has been provided in the pilasters to resist a wind load of 30 pounds per square foot of wall surface.

This intensity of wind pressure was assumed in the design of all of the buildings and it is interesting to note that the severe storm which occurred last September did absolutely no damage to any of the Cotton Warehouse structures.

The face walls along the sides of the buildings were made 8" thick, this being as thin a wall as can be satisfactorily poured. Temperature reinforcement was provided in these as in the fire walls, $4/10$ ths of 1% being placed horizontally and $2/10$ th% vertically. The reinforcement in all walls was equally disposed near each face of the wall, the outermost bars being kept $1\frac{1}{2}$ " clear from the face of the wall to provide adequate protection from fire.

Soil conditions were such that pile foundations were necessary for all structures. Comparative cost studies were made for fire wall footing designs based on untreated piles and on treated piles. Using untreated piles it would be necessary to extend a concrete pier down to such a point that the cut off of the piles would be at or below the plane of saturation, but with creosoted piles the point of cut off could be practically at the surface of the ground. It was found that the creosoted pile design was the cheaper. Fifty-foot piles were used loaded to about 12 tons per pile by the dead weights alone of the structure, which might be increased to about $14\frac{1}{2}$ tons per pile by the combined action of all possible live loads. It was assumed that the crane live loads would be spread along the length of the wall on a two to one slope.

Along the sides of the warehouses are elevated platforms or balconies. These consist of a slab carried on beams and girders, the girders being supported at one end by the face wall of the building and at the other end on independent columns.

The balconies, and the runways to which they connect, were designed for both concentration and uniformly distributed live loads.

Expansion joints were provided at frequent intervals in the balconies and runways and in the buildings themselves. The structures were entirely separated at these, being in effect independent structures a few inches apart. In most cases the structures on each side of an expansion joint rested on a footing common to both, thus maintaining both at the same relative elevation in case of any settlement.

The compress building is a one-story structure about 230 feet wide and 410 feet long, with a 22-foot story height. The roof is perhaps the most interesting portion of this structure. It is of the ribbed slab type, supported on beams extending from column to column in the direction of the length of the building. As will be seen in Figure 5 alternate panels of this ribbed slab are raised along one edge, thus forming saw teeth.

Tie beams, which can also act as struts, were provided under the saw teeth at each column. These take any pulls or thrust caused by contraction or expansion of the building.

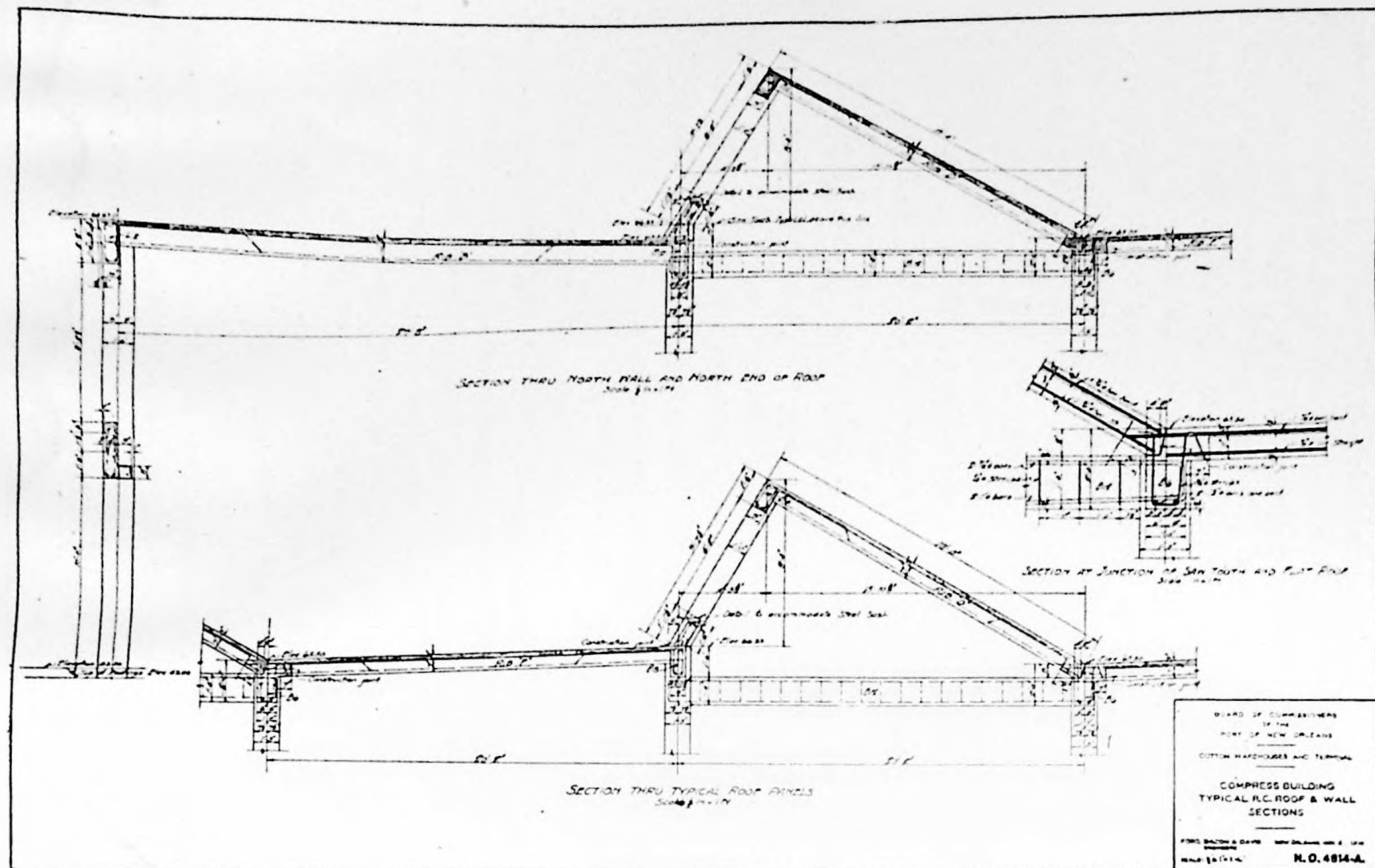


Fig. 5.

The construction of the compress was simplified by allowing in the design for pouring the nearly level portions of the roof, and allowing them to set, before pouring the inclined or saw tooth portions.

The Wharf House is a two-story reinforced concrete structure 122 feet wide and 2,000 feet long, of which about 1,500 feet is to be built at present. Both floors are reached by runways connecting with the other buildings and inclined elevators will be provided to transfer trucks and trailer trains from one floor to the other.

Figure 6 is a cross section of the wharf house. Along the shore side there is a 15-foot covered receiving and handling platform, while on the river side, but not shown in the drawing, is a 45-foot timber apron wharf. This apron wharf is paved with creosoted blocks and carries two railroad tracks and the lower rail for the wharf cranes. The second story of the wharf house is of about 20 feet less width than the first story, providing a platform on the river side from which cotton may be handled by the wharf cranes directly to the hold of a ship. The building is divided by fire walls into sections about 250 long.

The Wharf House is supported on a foundation composed of clusters of untreated piles cut off at low water. These are capped with timbers, some of which are continuous and maintain the desired relative position of the various clusters. Reinforced concrete spread footings rest on these caps and carry the superstructure. The columns supporting the first floor are connected in groups of four or six by a system of reinforced concrete X braces, thus forming rigid bents or towers.

The floors and roof of the wharf house are of what is known as the flat slab type of reinforced concrete construction, consisting of a slab of concrete supported directly on the columns without the use of beams or girders. A careful cost comparison was made between this type of construction and the more usual beam and girder type, and it was found that the flat slab floors were quite a good deal cheaper than beam and girder floors of the same carrying capacity. The flat slab type of construction has many advantages other than its low cost—among these may be mentioned the small amount of head room which the con-

struction occupies and the great resilience and consequent ability to absorb shocks and to adjust itself to slight settlements.

The only possible objection to the general use of the flat slab type of construction heretofore has been the scarcity of accurate knowledge of its structural action. Data obtained in the last four or five years from research work on this type of floor has largely removed this objection, and, as a consequence, the flat slab type of construction is being very extensively used, especially in warehouse and factory construction. In fact the demand for the flat slab type of structure has been so insistent that several cities have recently adopted amendments to their building codes or special rulings covering flat slabs.

The design of the flat slab floors and roof in the wharf house is largely based on such a ruling which was issued by the City of Chicago in the latter part of 1914.*

The Chicago ruling permits the use of what is termed the two-way system of reinforcement in which the steel is arranged in two directions parallel to the sides of the panels, and also of the four-way system in which the steel is arranged in bands spanning from column to column, both along the sides of the panels and diagonally.

Comparative cost estimates showed the two-way system to be slightly more economical for the spans and loadings required in the wharf house and therefore this was adopted.

Figure 7 gives detail sections through the second floor flat slab and indicates the arrangement of the reinforcing bars.

The Chicago ruling considers the floor to be divided for the purpose of analysis into two sets of broad beams or slabs, at right angles to each other, each set of which carries one half of the load, and each contains one-half of the reinforcement.

The ruling defines the magnitude and distribution of the bending moments for which these beams must be designed.

Before adopting this ruling as the basis for the design of the wharf house floors, its requirements as to magnitude and distribution of bending moment were investigated to ascertain whether or not they would insure a safe and satisfactory structure. The flat slab is beyond the range of a purely mathematical analysis.

*"Ruling on the Design of Reinforced Concrete Flat Slabs in the City of Chicago," issued by Henry Ericsson, Commissioner of Buildings, August 18, 1914.

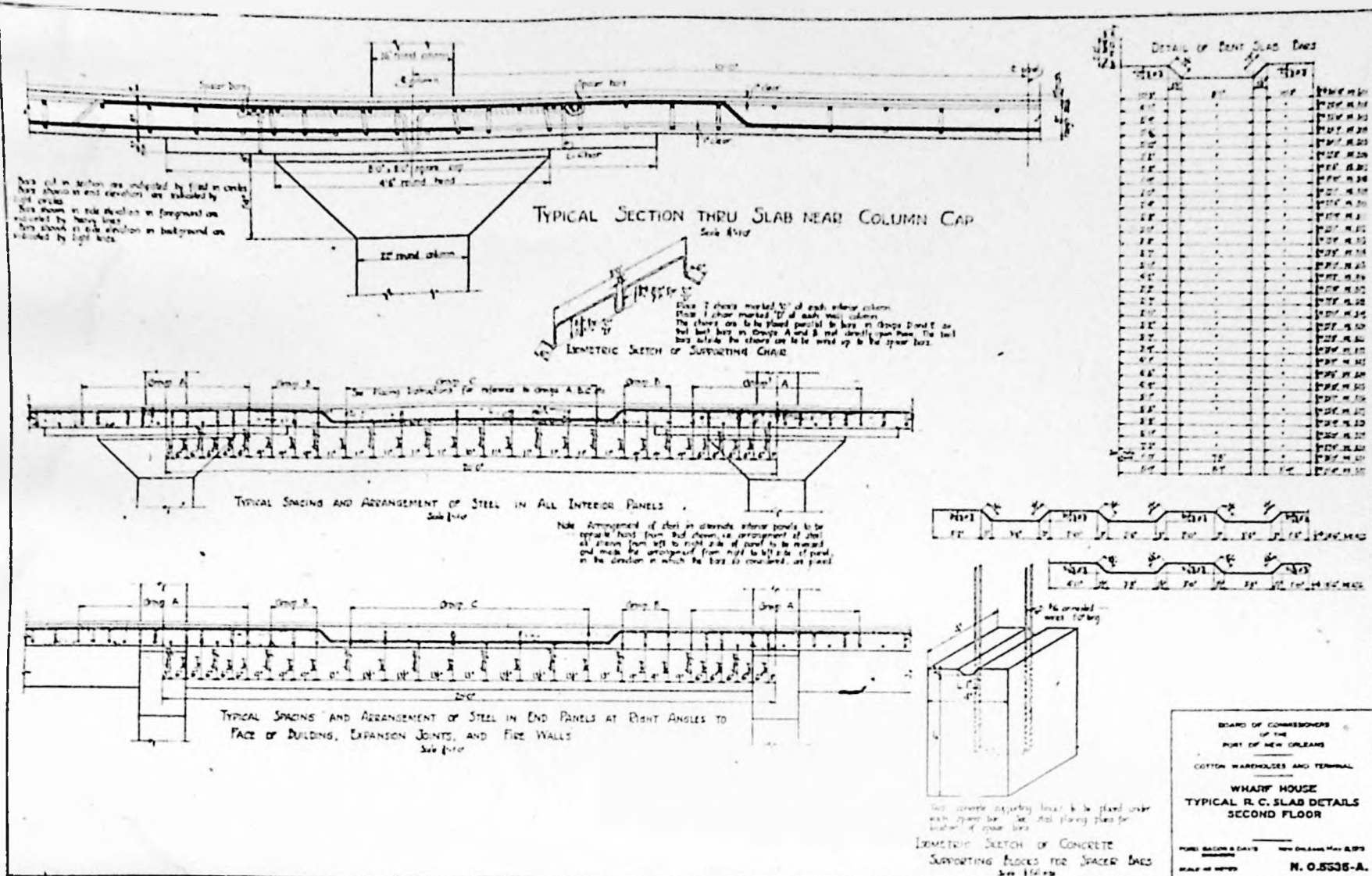


Fig 7.

We may, however, base an analysis on certain assumptions which appear reasonable and carry this to a certain point by mathematical methods, but from this point on recourse must be had to experimental data for the satisfactory completion of the analysis.

Figure 8 shows a plan of a portion of a continuous flat plate. This plate is supported on columns so spaced as to divide it into rectangular panels L units square.

The plan shows four such panels and portions of others. For the purpose of the analysis we will assume the flat plate to be divided into two sets of strips at right angles to each other and parallel to the sides of the panels, corresponding in direction to the two sets of reinforcement which we propose to install.

We will assume that each set of strips carries an equal share of the load on the plate and that this half of the load is uniformly distributed over the entire surface of the strip.

One of the strips of one set is shown by the hatched area on the plan.

Referring to the plan, and to the cross section of the strip, it will be seen that the strip is L units wide and that it overhangs the columns upon which it is supported an equal distance on each side.

We will consider this strip as a wide beam continuous over an indefinite number of equal spans. The figure shows an elevation of a portion of one of these strips or wide beams and illustrates our assumptions as to manner of support and distribution of loading.

Referring to this elevation, it will be seen that our strip or beam is nothing more nor less than an ordinary, continuous beam, carrying a uniform load. The bending moments for such a beam are known. At the support the moment is equal to the load per unit of length multiplied by one-twelfth the square of the span, and at the center the bending moment is equal to the load per unit of length multiplied by one-twenty-fourth the square of the span. The shape of the moment curves for the continuous beam is shown in the figure, the moments being the ordinates from a straight line to a parabola. In the case of our broad beam the load per foot of length is equal to the load per square foot multiplied by the width of the beam, or if small w

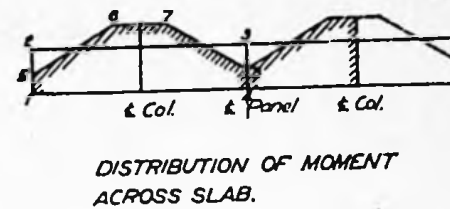
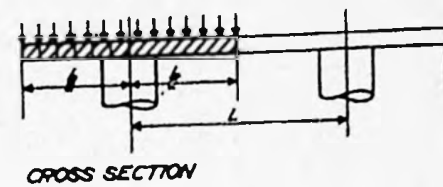
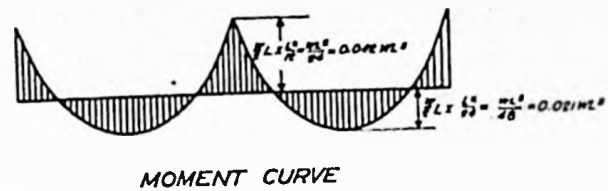
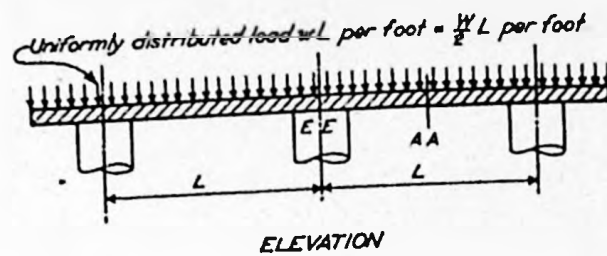
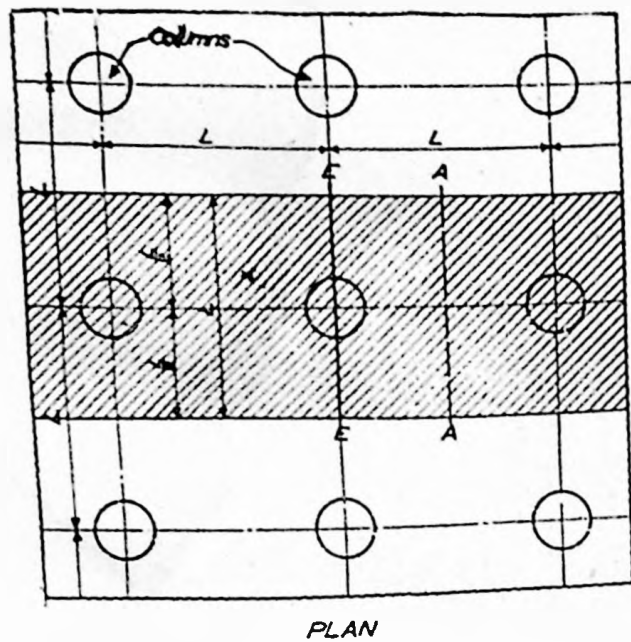


Fig. 8.

is the load per square foot on the beam and L its width, the load per linear foot of the beam will be small w multiplied by L . Since we have assumed that the beam carries a unit load equal to one-half the total unit load on the flat plate, it follows that if large W is the load per square foot of the flat plate, the load per linear foot of our beam will be large $W L$ over two.

Taking $WL/2$ as the load per unit length in the formula for the bending moment for a continuous beam, we find that the moment at the support will be one-twenty-fourth large $W L$ cubed, or $0.042 WL^3$.

At the mid-point of the span the moment is $WL^3/48$ or $0.021 WL^3$. In other words, the total moment at the support to be resisted by the entire width of the beam across the line EE on the plan, is $0.042 WL^3$ and the total moment at the mid-point of the span to be resisted by the entire width of the beam across the line AA on the plan is $0.021 WL^3$.

If our beam were an ordinary narrow beam, the problem would now be solved, since we would be justified in the assumption that each element of width of the beam carried an equal share of the bending moment. Our beam overhangs the supports on each side, however, and it is therefore reasonable to suppose that the extreme outer edge of the beam will not resist as much bending moment as the portions of the beam near the middle of its width which span directly from column to column.

To illustrate this point one-half of the beam is shown in the cross section to be divided into narrow strips. If each strip were supported at its ends in the same manner, i. e., if the columns were as wide as the beam, it would be reasonable to suppose that each strip carried an equal share of the bending moment. In other words, we would assume that the distribution of the moment across the width of the beam would be uniform. This uniform distribution of moment could be illustrated by the line 1, 2, 3, 4, in the figure showing the distribution of moment across the slab. This figure is what might be termed a cross section of the bending moment curve and corresponds to the cross section of the beam above it.

The ordinate to the line 2, 3 at any point measured from the line 1, 4, represents the bending moment resisted by a strip of the

beam at the corresponding point and under our assumption of similar conditions of end support for all of the strips, all of these ordinates would be equal, as shown, and the line 2, 3 which may be termed the curve of moment distribution across the wide beam, would be a straight line as drawn.

In our wide beam, however, all of the strips are not supported in the same manner at the ends, those near the margin of the beam resting on unyielding columns. Because of these differences in the supports, we may expect those strips nearer the margins of the beam to carry less than the average amount of moment, and those strips near the middle of the beam to carry more than the average amount of moment.

The total moments would then be distributed amongst the varying strips somewhat as indicated, by the ordinates to same curve such as the line 1, 5, 6, 7, 8, 4.

We do not know what the exact shape of this line or distribution curve will be. We do know, however, that the area which it includes will be equal to the total bending moment to be resisted by the entire width of the beam. At the support across the line EE the area enclosed by the distribution curve will be equal to the total moment at the support of the wide beam, which we have found to be $0.042 WL^2$; and at the center across the line AA the area will be equal to the total amount for the wide beam which we have found to be $0.021 WL^2$. The Chicago ruling requires moments of resistance corresponding to these of $0.042 WL^2$ and $0.019 WL^2$, agreeing very closely with our analysis.

There is no feasible method of determining analytically the exact shape of the moment distribution curves and it is here that we must turn to empirical methods. A few years ago the author made a study of this problem as a thesis for a post graduate degree.² In this study the amount and distribution of the moment of resistance was actually measured on a flat plate of rubber. Rubber was chosen for the model because it fulfilled the requirements of reasonable homogeneity, low modulus of elasticity and the ease with which all of its physical characteristics could be determined in the laboratory. The models used con-

²C. E., Washington University, St. Louis, Mo., 1912. See "The Design of Concrete Flat Slabs" by F. J. Trelease, *Proceedings National Association Cement Users*, Volume VIII, 1912, page 218.

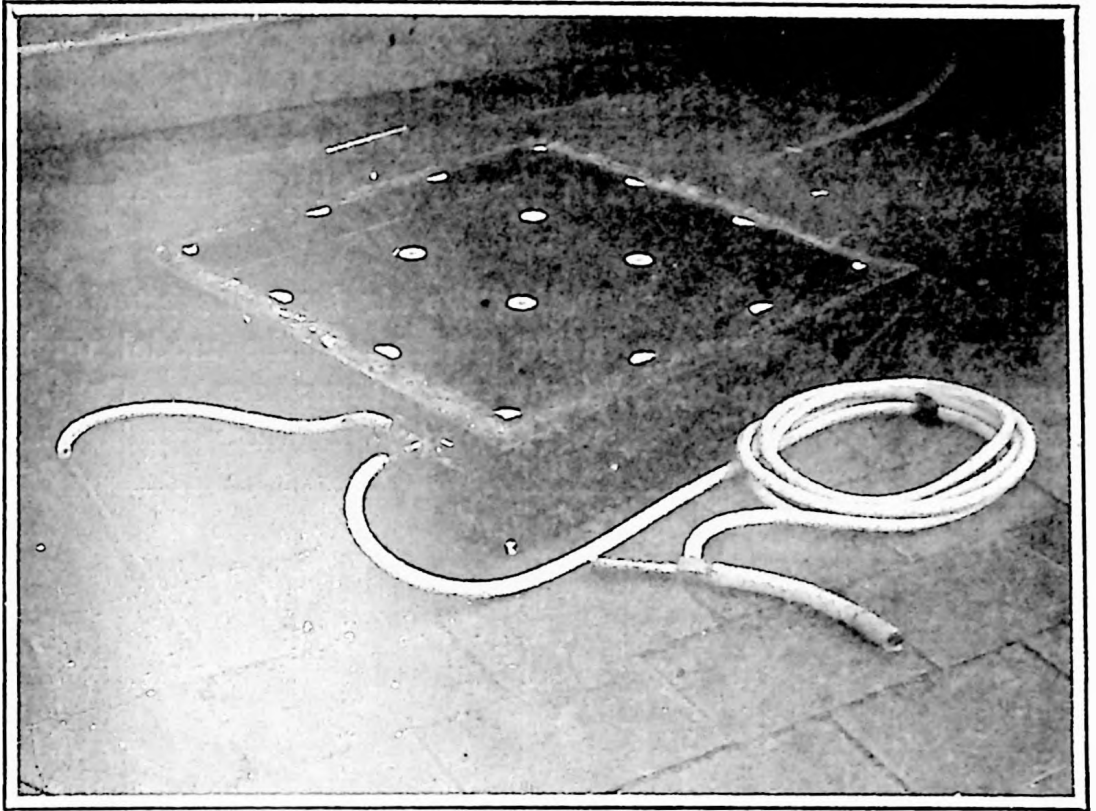


Fig. 9.

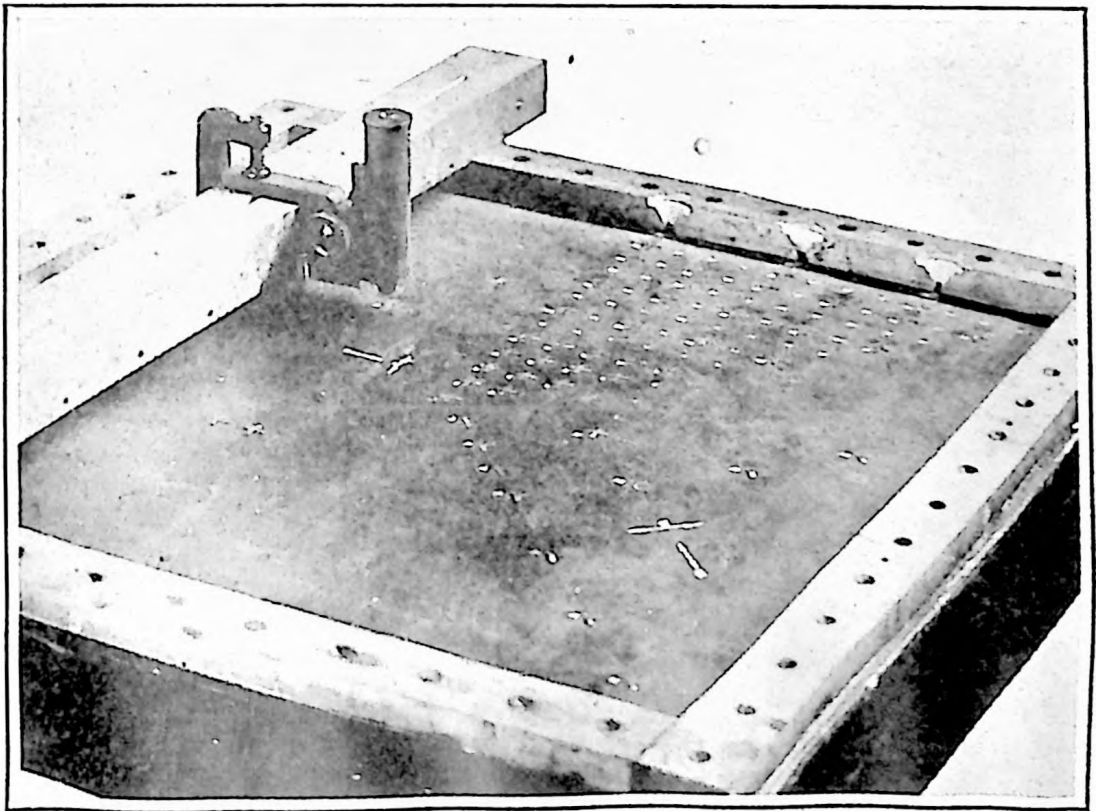


Fig. 10.

sisted essentially of a plate of pure gum rubber fixed so as to form the top of an air-tight box containing columns which divided the rubber plate into nine panels. This box before placing the rubber plate, is shown in Figure 9, while Figure 10 shows the model complete.

Load was applied by exhausting the air from the interior of the box, thus leaving the entire surface of the model unobstructed and free for observations and measurements. Careful deflection readings were taken showing that the plate under load

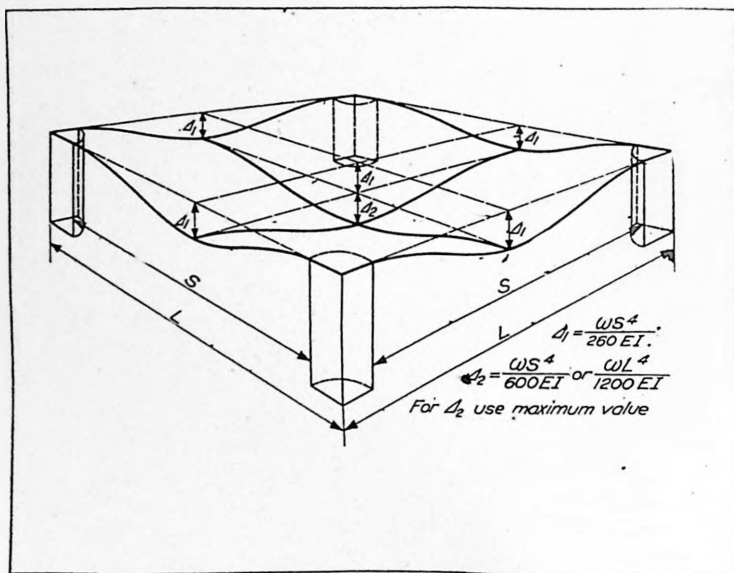


Fig. 11.

assumed the form shown in Figure 11. In addition to the deflection readings, the actual elongations of the extreme fibres of the rubber plate were measured at many points. From these deformations it was possible to compute the bending moments at all points of the slab. The deformations were measured by observing through a microscope fitted with an ocular micrometer, the changes in length occurring over $\frac{1}{2}$ -inch gauge lengths. The change in the $\frac{1}{2}$ -inch gauge length was brought within the range of the microscope by a special form of extensometer.

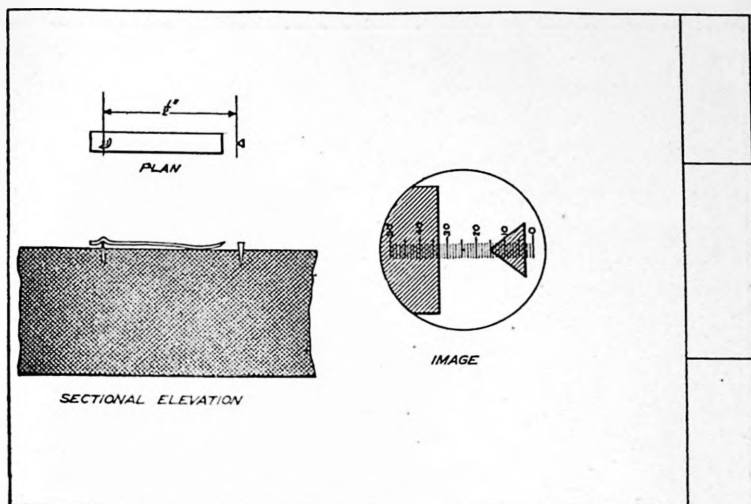


Fig. 12.

Figure 12 shows a plan and cross section of this extensometer and also its image as viewed through the microscope. From this Figure it will be seen that the extensometer consisted essentially of a small strip of brass pivoted at one end on a needle inserted in the surface of the rubber. The other end of this brass strip was carefully ground to a knife edge and highly polished. Near this knife edge end a small piece of needle ground to triangular shape was inserted in the rubber. The distance between the knife edge of the brass strip and one point of the triangular end of the needle was measured both before and after loading the plate, and from the measurements so taken the extension of the fibres could be readily computed.

Figure 13 is a photograph showing a few of the extensometers in place and also the lower part of the microscope with which they were read.

The extensometers were arranged in such a way that deformations could be read parallel to each side of the panel at points spaced one-eighth of the span apart.

Figure 14 shows the results of the extensometer readings at the margin of the panel and at the middle. The curve marked

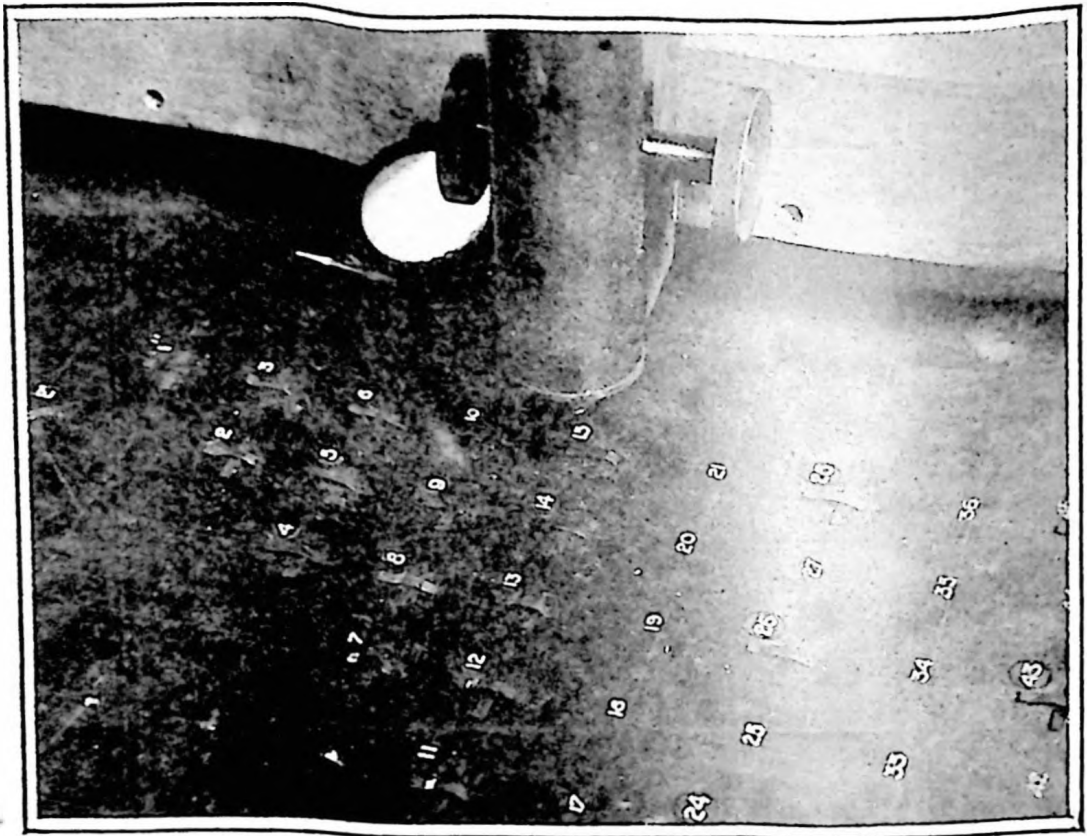


Fig. 13.

“Distribution of deformations across line EE” shows the variation of the deformation across the width of the panel at the margin, and the curve marked “Distribution of Deformations across line AA” shows the distribution of the deformation across the middle of the panel.

From these distribution curves, it will be seen that as might be expected, the strips at the sides of the panels, which span directly from column to column, resist a good deal more of the moment than do the strips near the middle of the panel away from the columns. These curves, as they appear in this Figure, indicate accurately the *distribution* of the moment as measured on the rubber model, but do not show the *amount* in terms of the load and span, since the unit of measure given is the division of the micrometer scale. To determine the value of one division of the micrometer scale in terms of bending moment a strip of rubber, cut from the plate, was supported as shown in Figure 15 and loaded in such a way that the bending moment at the center was known. An extensometer was placed at the center

and read under various loadings. The Figure shows the result of three independent sets of readings. It will be seen from this Figure that the error of observation was reasonably small. Knowing now the value of one division of the micrometer in terms of bending moments, the areas of the moments measured in the flat slabs can be computed. These are $0.023 WL^3$ at the

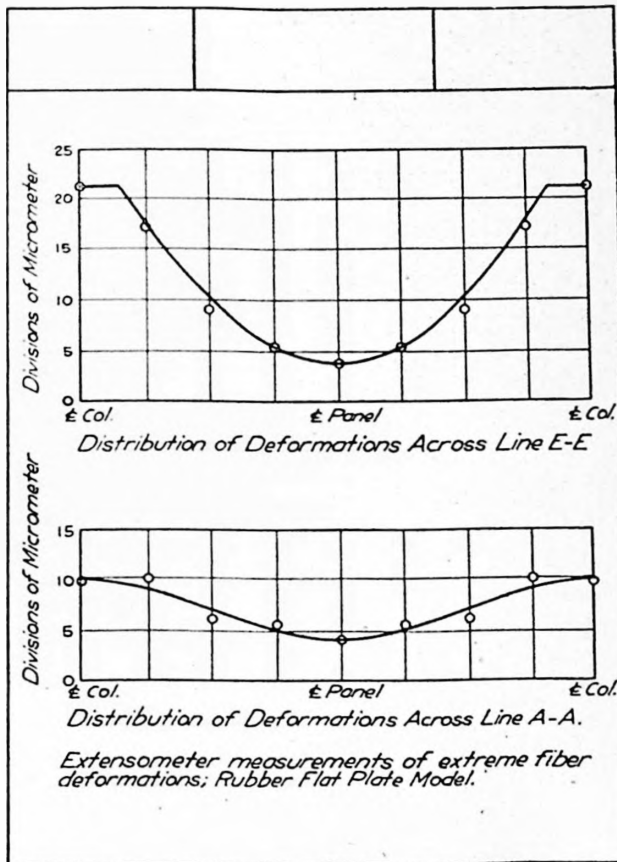


Fig. 14.

center of the span and $0.038 WL^3$ at the support as compared with $0.019 WL^3$ and $0.042 WL^3$ respectively required by the Chicago ruling and $0.021 WL^3$ and $0.042 WL^3$ as computed on the basis of uniform load distribution. These figures show the Chicago ruling requirements to be reasonable in so far as the total moments of resistance are concerned.

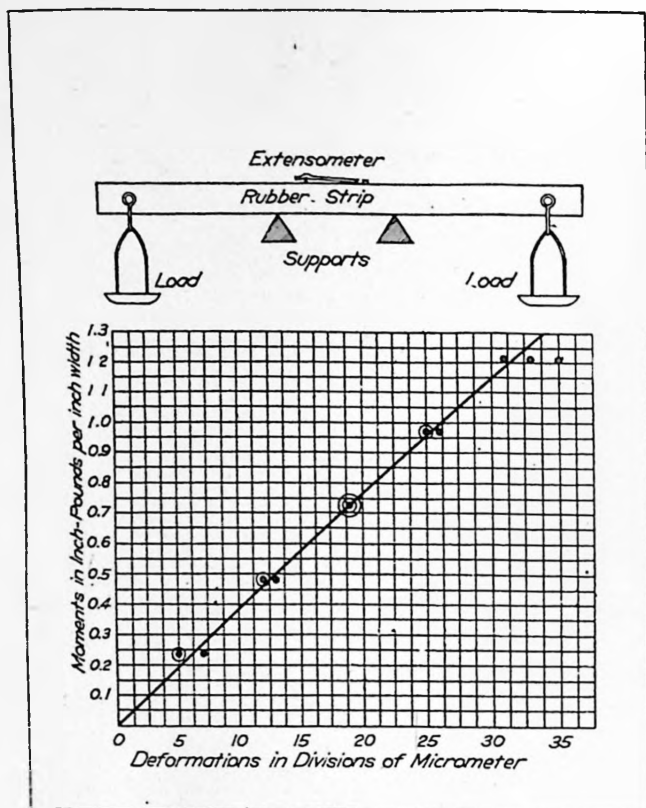


Fig. 15.

The application of data obtained from rubber models to the design of reinforced concrete structures might possibly be questioned in the absence of corroborative data.

In a paper read before the American Concrete Institute by Mr. W. A. Slater,^{*} such data appears in the form of a figure showing the moment of resistance measured in an actual test of a reinforced concrete building and a comparison of this moment of resistance with the moment of resistance measured on the rubber plate model.

Figure 16 is a reproduction of Mr. Slater's drawing from which it will be seen that the values measured on the rubber

^{*}"Test of a Flat Slab Reinforced Concrete Floor at Shredded Wheat Factory, Niagara Falls, N. Y.," by W. A. Slater. *Journal American Concrete Institute*, Volume II, No. 6, 1914.

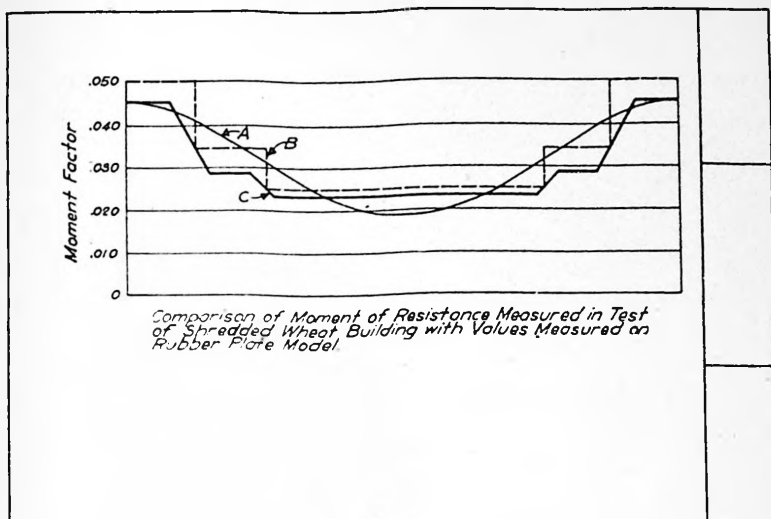


Fig. 16.

plate models agree very closely with those measured on the reinforced concrete structure. In this Figure the curve A represents the moment of resistance as measured on the rubber plate, the curve B represents the moment resisting capacity of the steel reinforcement in the structure tested, and the curve C represents the moment of resistance actually developed as computed from extensometer readings of the steel stresses measured during the test. This Figure would indicate that, not only is the total moment of resistance, as measured in the rubber model test reasonably correct, but also the distribution of this moment across the width of the panel.

In this figure, the moment factor is given in terms of the clear span and not in terms of the span from center to center of the columns as in the Figures which follow.

Figure 17 shows graphically the comparison of the amount and distribution of the moments of resistance as measured on the rubber plate model with those required by the Chicago ruling and with those actually adopted in the design of the wharf house.

The ordinates to the curves R represent the moments of resistance as measured on the rubber plate model. The ordinates to the heavy lines C represent the moments of resistance required

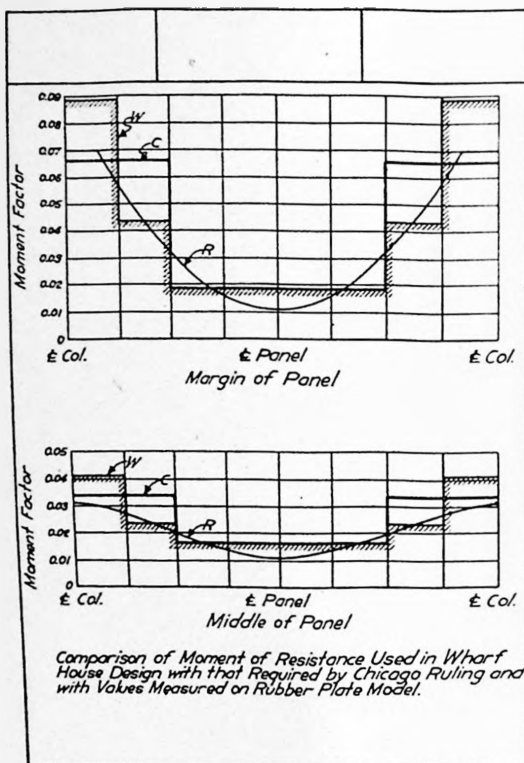


Fig. 17.

by the Chicago ruling. The ordinates to the hatched lines represent the moment resisting capacity of the reinforcement as arranged in the design of the wharf house. The total areas bounded by the lines W and C are the same. The deviation in the shape of the distribution curves was made because it was felt that the arrangement adopted more nearly conformed to the conditions which must be actually met, and that we should not ask nature to make too violent adjustment of her laws in adapting herself to our structure.

**DISCUSSION UPON "SOME STRUCTURAL FEATURES OF
THE COTTON WAREHOUSES AND TERMINAL."**

THE PRESIDENT: Gentlemen, you have heard this very interesting paper by Mr. Trelease, and I am sure that you have all found it very interesting, and no doubt, Mr. Trelease will be very glad to answer any questions that anybody may want to ask in connection with this paper. We would be very glad to hear from anybody who wants to ask any questions.

PROFESSOR DERICKSON: Mr. Chairman, it is very seldom the privilege of one to hear a design taken up in such detail, and this has been most interesting. However, there are one or two things which I would like to ask Mr. Trelease. In speaking of the percentage of steel allowed for contraction, I believe he stated $\frac{4}{10}$ of 1 per cent. Was that for the walls, and also for the floors?

MR. TRELEASE: That was for the walls.

PROFESSOR DERICKSON: What was used for the floors?

MR. TRELEASE: That was practically the same amount.

PROFESSOR DERICKSON: There is another thing, I believe, in the second diagram, where the stirrup spacing was indicated. (Inasmuch as details constitute such an important element in the strength of a reinforced concrete structure.) I thought the stirrup spacing rather exceeded the depth of the beam. Is that correct?

MR. TRELEASE: Yes. Those stirrups are not relied upon to resist the diagonal tension, but to tie the slab to the "T" beam. The reinforcement of the slab was in the bottom of the slab throughout the length.

PROFESSOR DERICKSON: And again, where you have the crane girders, are they attached to the wall, or do they rest on the pilasters?

MR. TRELEASE: They are attached to the wall. Each two feet of shelf would carry a crane wheel.

PROFESSOR DERICKSON: And the wall takes care of all the flexure as well as sustaining the direct loading, in other words, is flexure considered as being developed in the pilasters?

MR. TRELEASE: The bending is considered as being distributed by that beam along one panel-length of the wall, that is, through 16 feet, 8 inches of the wall, and the aggregate moment of resistance of that panel-length of the wall is sufficient to take care of the entire eccentricity.

PROFESSOR DERICKSON: And one other thing I would like to ask, if I may, in regard to flat slab construction:—Do you have to pay a royalty? It seems to be the opinion of many that if one employs that form of construction, a close cost estimate is difficult to arrive at on account of the various patents and corresponding royalties. There seems to be so much in the technical press, at present, about suits for infringement in connection with reinforced concrete construction that I appreciate this opportunity to talk to someone having had experience recently in regard to this type of construction. For instance, we know of the "Mushroom System" of Mr. C. A. P. Turner, and his patents, and I am interested in knowing what your status was; that is, were you, as a designer, permitted to design a flat slab floor and columns without fear of coming into contact with the courts?

MR. TRELEASE: There are some basic patents which have been sustained in the last year or so, that cover the basic idea of the flat slab of reinforced concrete, apparently. And in addition to those, there are patents for almost every system of reinforcement, covering specific details. The royalty, however, as a rule, is, in itself, a small amount. You can determine it in advance, usually, and add it to the cost of the flat slab structure, and you will find that even with that, the flat slab is desirable.

PROFESSOR DERICKSON: An interesting paper presented in 1910 by Mr. MacMillian of the Aberthaw Construction Co. discusses the flat slab design by various methods. This company has used this system, I believe, also other concerns make use of the girderless floor. Do these companies control patents on their particular systems, or does Mr. C. A. P. Turner?

MR. TRELEASE: No. Mr. Turner is on the wrong side of the fence on that. He claims, however, to be the originator of the whole system.

PROFESSOR DERICKSON: So I understand.

MR. TRELEASE: Yes, when he applied to the Patent Office, as I understand it, he had done a great deal of work on it, and for that reason his claims were very largely conceded, but I believe the Concrete Steel Products Company of Chicago owns some patents, which have been recently held valid, and which date back prior to Mr. Turner's patent. So that puts Mr. Turner on the same footing with all the rest of them,—that is, his patents are valid and good in so far as details are concerned, but not so far as the general basic idea of the flat slab of reinforced concrete is concerned.

PROFESSOR DERICKSON: I thank you very much for answering these questions.

THE PRESIDENT: Is there any one else who desires to ask anything?

MR. SCOTT: Mr. Trelease, I am going to ask you if any royalty was paid on that particular job?

MR. TRELEASE: I am not prepared to answer that question. It is a matter of business arrangement. Royalty was figured in the cost of the design: I can say that much.

MR. SCOTT: Now, another question: You spoke of reduction in the stresses in the columns on account of the least side of the column exceeding a certain ratio of the length. What reduction do you make on that?

MR. TRELEASE: We reduced it in the ratio of the least side, expressed in inches, divided by the length in feet. That is, if a column was 12 inches least side and 12 feet long, we would use the Joint Committee stress. But if it were 12 inches least side and 18 feet long, we would use 12/18 of that.

MR. SCOTT: That would be reducing $\frac{1}{3}$?

MR. TRELEASE: Yes.

MR. SCOTT: Do you know of any particular rule on that point?

MR. TRELEASE: There is not very much on that point. That particular rule was—well, it has been in use in the city of Detroit and the city of Cleveland, in their building codes—it has been incorporated in their building codes I think for some

time. It seems fairly reasonable. It didn't make very much difference one way or the other in the cost of the structure which particular rule we adopted, so we tried to tie down to a public building code rule. It is usually something that has been already investigated before the adoption in the code.

MR. SCOTT: Now, you used different grades of steel in that. Does that make any difference in the stresses?

MR. TRELEASE: No. We used 16,000 pounds throughout. With hard grade steel you would get the benefit of a greater factor of safety, you might say, but the deformation at 16,000 pounds per square inch is the same in hard grade and structural grade, and it is about enough. You see, cracks have been found in concrete at a steel stress of about 3,000 pounds to the square inch, and if you really work steel up to 16,000 pounds per square inch, which you very rarely do, however, it means very visible cracks, and the public have a way of stampeding when they see cracks in concrete buildings.

THE PRESIDENT: Gentlemen, we would be very glad to hear from any one else who desires to discuss this subject.

MR. OLSEN: Mr. President, it might be of interest to you people to know (Mr. Trelease having spoken about Chicago's building code) that they have adopted some rules for figuring on flat slabs. Here, in this good old city, where you have got iron bound rules for the old construction of slabs and beams, we are held down very tightly to a stress of 650 pounds for compression of concrete, 500 pounds, I think, for compression of columns, and 16,000 pounds for steel, in the old beam and slab construction. But when it comes to flat slabs, why, we can do any blessed thing we want. All we have got to do is to go to the City Hall and say: "Well, it is a flat slab," and they will let it go through, as long as you agree to put on a live load, or stress load of twice the live load. But if I go to the City Hall and say I will do the same thing on a flat slab, according to the beam and slab construction, they say: "That don't go. We know how to figure the other, but not the flat slab."

And that is where we are to-day. It certainly would be a good thing if we could get down to some rules so that we would know just how to figure, and what to figure?

Now, Professor Derickson was speaking about the royalty. As far as I know, Mr. Leonard is collecting royalty all over the country to-day for anything that is put up with flat slabs. I looked into the subject and I got the answer from Mr. Leonard, or from the Concrete Steel Products Company, that it would be perfectly satisfactory for me to get out a flat slab system and call it anything I want, for instance, the O. K. system, provided I would pay him a certain royalty. It was on a sliding scale, decreasing down to a quarter of a cent per square foot. I believe it depended upon the amount of floor space which I could design during the year. And as I understand it, everybody is in just the same boat to-day. Mr. Leonard or his company has written to every architect and engineer in the country that it will be perfectly agreeable for them to design on the flat slab system, as long as they will register with him and apply for a license, and then he will leave it open to themselves to figure their own system and call it the O. K., or whatever it might be. I took the position that while we might design flat slab systems as good as anybody's, we might run into fifty to a hundred types of construction, on which Jim Jones might have a patent for bending bars another way, so we decided, therefore, not to bother about getting out any special system, but to pay Mr. Leonard a royalty, and if we got an opportunity to use it, why, we would let one of these licensed companies that has got a license and has got his patent—let them handle it, and therefore, I think we will let the matter stand at that.

MR. TRELEASE: Mr. President, Mr. Olsen spoke about getting a standard for figures for flat slab floors. The Joint Committee is going to hold a meeting in Chicago to-morrow to consider that subject, and I think before long the result of their deliberations will be made public. That ought to give us all a pretty good basis as far as designs are concerned.

THE PRESIDENT: Gentlemen, I am sure we found this discussion interesting, and there may be still others who would like to say something on the subject, and we would be glad to hear from any others. Mr. Cappell, would you like to say something on that subject? I believe you are interested in reinforced concrete.

MR. CAPPELL: I am greatly interested in it, and I was very much interested in the discussion. The question of reinforced concrete is one of vital interest, I think, for discussion, especially at the present time. But I have nothing in particular to say on this design—on the design of the cotton warehouses—except in a general way, and that is on the construction, reinforced concrete construction in general. I see no reason why we should confine ourselves to the old, stable methods of construction. I see a great future for reinforced concrete. I believe it lends itself more readily than any other building material to design and to construction of anything whatsoever, and I believe we can build our houses and our warehouses and our bridges and our highways and almost anything we want out of reinforced concrete, and I certainly appreciated the discussion by the gentleman on the warehouses.

PROFESSOR DERICKSON: Mr. Chairman, I would like to ask just one more question of the gentleman, if I may. Judging from your experience, if you had a design, say, for a building to carry a certain known load, and you went around the country, say from San Francisco to Portland, Maine, picking out ten engineers of experience and training, and asked them for a report on the flat slab system with regard to unit stresses, what variation would you anticipate in their answers as to the unit stresses induced in the steel and concrete? Has it been your experience that there is much of an agreement, or would you expect a comparatively uniform agreement?

MR. TRELEASE: Well, there has not been such very good agreement on that. The flat slab has been in about the same stage of development that reinforced concrete as a whole was about ten or fifteen years ago. Everybody has his system and claims miraculous things for it, and pretty nearly every engineer that you would ask to figure on a flat slab might have a system of his own. He would use that to investigate the slab with:—his own method, his pet scheme. I think, however, that the Chicago code represents more nearly than anything else available the crystallization of the good features of all of these systems. That was drafted, after a great many special rules for each system had been drafted, by a committee who were very well up on the sub-

jeet and had all of this experimental data at their command. I think the Chicago code represents about what a person ought to do in the absence of any other information. Of course, if a man knows something which is not in the Chicago code, all right and good,—if he knows his method to be correct; but we should accept it with caution.

PROFESSOR DERICKSON: After reading the discussions in the transactions of the American Society of Civil Engineers that have appeared in the past year, regarding various tests, I personally have felt rather more at sea than before.

MR. TRELEASE: Everybody seems to have that idea. Everybody designing flat slabs thinks he has the right method. I personally have made a great many tests on reinforced concrete flat slab floors, and have found that individual characteristics will develop, that is, because of local conditions, one panel will not test like another; you cannot take one test of a concrete flat slab floor and base a flat slab design on it. Too much of that has been done, I believe.

PROFESSOR DERICKSON: But the spacing of the columns, that is, the size of a panel, and whether it is square or rectangular, does not seem to show much of a difference, or does it run fairly uniform?

MR. TRELEASE: It runs fairly uniform for square panels of ordinary sizes, but to change from square panels to oblong or rectangular panels, there is a great deal of difference.

PROFESSOR DERICKSON: There is one other thing, Mr. Trelease. Have you read the articles of Mr. Godfrey, of Pittsburg, who seems to disapprove of the use of the stirrup? He has published articles in the engineering papers, which some engineers seem to consider very favorably. I believe he claims that the stirrup is not only wasted, but is detrimental as it is of little service and it adds more weight to the beam, and he seems to be perfectly sincere in his remarks. If you had to refute such an argument, what would you put forward to show that he is wrong? It seems that it is a pretty fair question, and if he does not have the right idea, I don't understand how he could get the consideration which he receives.

MR. TRELEASE: I have never thought of that. I have always accepted stirrups as being a proper proposition, and I think they are a good investment.

PROFESSOR DERICKSON: That is my opinion, but I thought possibly you might know of something that the rest of us have not been fortunate enough to find out, which might throw some light on his argument.

MR. TRELEASE: I am not very familiar with his argument.

MR. CAPPELL: In speaking of the flat slab construction, it occurred to me that I had read an article the other day—I forget the writer—where he stated that the concrete in the slab had absolutely nothing to do with the strength of the slab; in other words, he argued that the steel was the sole strength—that he had taken a slab, I forget the dimensions, and cut out the concrete in such a manner as to make the fiber stress of the concrete 7,000 pounds to the square inch, and then had tried the load on this slab, and that the slab had not crushed a bit, it hadn't failed in crushing, as the concrete, the upper fiber, showed no crushing at all, and that it failed in the tension. Of course, that was a continuous slab, or a continuous girder. And he had taken this and cut it out at the support on the bottom, and at the top and in the center, so as to make his stress 7,000 pounds to the square inch. I think that may have some bearing on your stirrup question. In other words, if you take your steel and put it at the bottom of your slab, in the middle, and at the top of the supports, you get that lever on to the steel which is the only strength of your continuous slab, according to this man. And then, if it is not continuous, your beam or slab will fail in the diagonal tension, if it has no stirrup. There is no doubt of that, because I guess all of us have broken any number of them. I know I have. His argument, I think, calls for thought on the subject. I have not had a chance to go into very deeply, but it seems to me that that is a thing which will bear a great deal of investigation.

PROFESSOR DERICKSON: You mean that the steel which is used in the stirrups might better be employed in the longitudinal reinforcement?

MR. CAPPELL: Well, not exactly that, no. The thing is this: In the simple beam or slab, I believe in the efficiency of the stir-

rup. Of course, I have made a great many tests that lead to that belief; but in the continuous beam or slab, I don't say that I agree with this man, but he claims that the steel, alone, gives the strength.

PROFESSOR DERICKSON: In a continuous beam?

MR. CAPPELL: In a continuous beam or slab. In other words, if you have a continuous beam and have no continuous reinforcement in the tension side of the beam, that beam will crack.

PROFESSOR DERICKSON: Then, you won't have a continuous beam.

MR. CAPPELL: Then, you will not have a continuous beam.

PROFESSOR DERICKSON: If you have a continuous beam, you certainly will have sheer, just the same.

MR. CAPPELL: But your sheer is taken up, if your steel is perpendicular to the line of diagonal tension.

PROFESSOR DERICKSON: Suppose you take a beam say 50 feet long, supported at intervals of say 10 feet; suppose you run a continuous line of rods in the bottom and then put some rods at the top, but you don't bend up any rods at all—

MR. CAPPELL: You have no connection at all between your top and bottom reinforcement. Then it remains for the concrete to distribute the sheer from the bottom to the top, and if your concrete is sufficiently strong to do that, it will do it; if it is not, it will not do it.

PROFESSOR DERICKSON: That is exactly true, but if you don't put your stirrups in, why, you certainly are working at a reduced stress.

MR. CAPPELL: Oh, yes. I am a believer in stirrups. Your stirrups in that case would merely be a substitute for trussed bars. It would be simply the distribution of your steel in several parts.

MR. TRELEASE: Are you arguing in favor of the suspension system?

MR. CAPPELL: I was just giving my conception of what I had gathered from that.

PROFESSOR DERICKSON: Did not the tests in connection with the Boston Subway indicate that such an arrangement of the reinforced cement was less satisfactory?

MR. TRELEASE: I think the Boston Subway tests showed that up. That has been shown several times by tests. I think the discarding of that type of reinforcement is the best argument.

MR. CAPPELL: Understand, I am not arguing in favor of it, because I don't believe that way, but I am just giving my conception of what this man has written, and I think it will bear study.

THE PRESIDENT: Gentlemen, is there any further discussion? I am sure we feel grateful to Mr. Trelease for his paper, and to the other gentlemen who have entered into the discussion. Free discussions such as we had this evening certainly tend to develop the subject and to bring out the interesting points, and I am sure we are all glad when we have such a free discussion as we have had this evening.

OUR NEW QUARTERS.

By
J. M. ROBERT.

The members who attended our last monthly meeting were agreeably surprised. We had been used to meeting in the old lecture room downstairs. On entering the building to attend last meeting we found the lecture room dark. We were directed upstairs. Our way through the dimly lighted halls of the historic old building ended in a large hall, brilliantly lighted, with polished floors, the air pervaded by the odor of fresh paint—a distinct breath of the present amid the mustiness of the past. This room is our new and permanent home, situated on the second floor of what is known as the old Presbytery.

An effort to find the history of the building proved interesting indeed, even if unavailing. Time did not suffice to read in detail the countless documents of the Cathedral archives and the old official records of the City of New Orleans, but a glimpse of the former and a fairly complete scanning of the latter—all well over a century old—failed to reveal anything much about the early history of the Presbytery. The history of the building on the other side of the Cathedral, the Cabildo, is fairly complete, due to its greater historical interest.

The earliest record of the Presbytery occurs in the notes of a meeting held Nov. 2, 1738, by the inhabitants of the colony who assembled to discuss ways and means of raising the necessary funds for the erection of a presbytery. The project was abandoned, however, until 1744, when it was revived and the following resolutions adopted: "A tax of fifty cents will be imposed upon all the inhabitants of the Parish for each and every head of negroes. In addition to this, the inhabitants have agreed upon a personal tax proportioned to the amount of real estate owned by them, said amount to be decided by a board of ten of the most prominent citizens." In this way the Presbytery was erected as a residence for the priests of what was then the St. Louis Parish Church. In passing, it might be noted from the above extract that even in those early times the "prominent citizen" had already made his appearance as an inhabitant of

this earth. It is peculiar, too, that after these many years no successful antidote for the same seems to have been found.

On March 21, 1788, these buildings were destroyed in a great conflagration which swept a large part of the city. In 1794 the present Cathedral was built. The site of the Presbytery was sold to the city, and in 1813 the present building was erected for a court house.

As a digression, we wish to record the exquisite interest of going over these old records. In these days of typewriters and printers' ink it seemed strange, indeed, to read official documents in handwriting. Handwriting of all kinds, large, small, bold, fine,—but uniformly good and legible. As you read you could not help but feel that in those days everyone had time to write legibly. The paper, too, is excellently preserved after all these years—nor does the ink seem to have faded at all. The Mississippi river was a source of worry then, as now. Plans by Latrobe, the engineer and builder of our first waterworks, were found; these plans detailing suggested methods of closing crevasses.

We have cause to be proud of our new quarters. The interior has been entirely renovated, lights installed, and a handsome new polished floor laid. The appearance as a whole is particularly pleasing, and we consider ourselves fortunate, indeed, in having such quarters. The many large doors give an abundance of light for those who read there in the daytime. Interesting, too, is the outlook on historic Jackson Square, a suggestion of which is gleaned from the photograph. The graceful arched transoms, also seen in the picture, were plastered up. They were uncovered during the renovation and add quite considerably to the general appearance.

On the walls of the room hang the photographs of all the past-presidents of the Society, together with their signatures. The collection of all these was an arduous task and was undertaken during his presidency as a work of love by our latest past-president, Mr. Datz. The success achieved as a result of his labors is apparent upon an inspection of the room.

This article would not be complete without mention of the many kindnesses of which we have been the recipient. Mr. John Riess, one of our members, undertook the work of renovation at actual cost, and was unsparing in pains and time. Mr. Frank G. Churchill kindly designed and furnished the plans by which the work was done. The Southern Pine Association donated to us the floor, which was specially and carefully selected. To all of these gentlemen we extend our warmest thanks.

SPECIFICATIONS FOR WOODEN PILES.

(The following short article has been received by Mr. Samuel Young from Mr. E. P. Goodrich, Consulting Engineer to the Commissioner of Public Works, Borough of Manhattan, New York City, on the question proper specifications for wooden piles. It is published here, along with some comment from Mr. Young, with the idea that the points brought out might lead to a general discussion of this topic, so important here in New Orleans, where wooden piling is used so extensively. Editor.)

Why Not a Rational Specification for a Wooden Pile?

By

E. P. GOODRICH.

The typical specification for a wooden pile, as used by most railroads, municipalities, etc., and as advocated by most producers, reads about as follows:

The pile shall be so straight that a line stretched from center of butt to center of point will not leave the pile more than $1/100$ th (for example) of the length of the pile.

Several criticisms instantly arise in one's mind as to this specification.

1. It is obviously impossible to stretch a line from center of butt to center of point; and therefore a substitute method has to be employed, which latter should logically also be substituted in the specification. Obviously the pile will naturally lie on a flat surface so that its greatest curvature is horizontal. A line is then stretched from the butt to the point over the center of each; and, by sighting down vertically along the string, the distance between the projection of the string and the side of pile is noted.

2. What relation should exist, if any, between the crookedness of a pile and its length? Obviously, again, the pile must be straight enough to be placed in the pile-driver. It also must not be so crooked that a blow of the hammer will bend it so as to damage it; and it must not be so crooked that its final load will produce a bending moment in the pile so large in amount as to produce stresses exceeding a safe maximum. This load condition

and the phenomena during driving are practically identical in nature, except that one is static and the other dynamic. Now the theory of bent columns, or what is the same thing,—of eccentrically loaded columns, or of arches, must of necessity apply to piles.

Again it is obvious that with relation to members of the general size and shape of piles, the length has no effect upon the stresses due to eccentricity of loading at any section,—the latter being due only to the amount of the eccentricity and the area of the corresponding section.

3. What should be the maximum permissible crookedness? It would seem that it should depend upon the permissible maximum bending stress for the material composing the pile and of the area of the latter. Most engineers would doubtless concede a relatively high unit stress as permissible for the condition of combined direct stress and bending of a pile. From this, it is seen that when all piles are designed to be uniformly loaded when finally in place, a greater bend is permissible in a pile of large diameter than in a smaller one because a less unit direct stress will exist in the large pile and a greater one due to the eccentricity of load may be allowed. Such a specification may not make inspection easy and may possibly be considered impracticable for other reasons, but its logical possibility is evident.

Of course different kinds of wood must have different permissible bends. Also, the designer's load per pile will influence the allowable bend, if the limit placed on the total maximum unit stress is constant.

Assume for example, a 12-inch round pile, area where bearing on soil commences 100 square inches, designed loading per pile 15 tons or 30,000 pounds. Then the direct stress per square inch is 300 pounds. If a safe total unit stress of combined compression and bending of 2,400 pounds is assumed (the recommendations of the Committee on Wooden Bridges and Trestles of the Am. Ry. Eng. and M. M. Assn., Vol. 10, part 1, p. 564, are for long leaf pine 3,800 ultimate, 1,300 safe stress, $1,300 (1 - L/60D)$ for long columns, 6,500 ultimate extreme bending, 1,300 safe) then 2,100 pounds may roughly be assumed as the maximum permissible bending stress due to eccentricity of load at the section.

Since the moment of inertia is about 1,016.164 and the section modulus is 169.364, the maximum permissible eccentricity of stress at the ground level would be 11.9 inches. Again at a point approximately 8 inches in diameter where the total direct stress may have been reduced by half, with an area of about 50 square inches, the permissible bending stress may be assumed at 2,250 pounds. The moment of inertia is 196.704, the section modulus 49.176 and the permissible eccentricity 7.4.

Examples might be multiplied; but it would seem evident from the two given that a modification in the type of specification now in use might be advantageous. It seems obvious that the permissible bend should not be measured in terms of the length of the pile, but rather in terms of its diameter at each point along its length. With this idea in view, the following wording with reference to yellow pine piles is submitted for criticism:

The pile shall be so straight that a line held in contact with any two points selected so as to give the maximum deviation shall not be distant from the surface of the pile at any point more than the diameter of the pile opposite that point.

Mr. Young comments as follows upon these suggestions and also submits a copy of the specifications he prepared for the Board of Port Commissioners of the Port of New Orleans at the time he was the Engineer for that Board:

“Mr. Goodrich assumes that piles act as unbraced columns, which is rarely the case except for the portions above ground in trestle work. Around New Orleans we depend almost entirely on “skin-friction” for carrying power.”

Specifications for Wooden Piles.

Piles shall be cut from live trees, and shall have the bark thoroughly peeled off; by “thoroughly peeled” is meant that strips of the inner bark which may be left on piles shall not exceed one inch in width and six inches in length. Piles shall be sound, free from wind shakes, unsound knots, or other defects which would impair their strength; they shall be sufficiently

straight for all practical uses, which means that they shall be straight enough to drive at a given location without unreasonable difficulty. They shall measure not less than 14" or more than 18" in diameter at the large end, and the minimum diameter at the small ends shall conform to the following:

Piles 40' long, not less than 9"

Piles 45' long, not less than 9"

Piles 50' long, not less than 9"

Piles 55' long, not less than 9"

Piles 60' long, not less than 8"

Piles 65' long, not less than 8"

Piles 70' long, not less than 7"

Piles 75' long, not less than 7"

Piles 80' long, not less than 7"

Piles over 80' and not in excess of 95' in length, not over 18" in diameter at the large end and not less than 6" in diameter at the small end will be required.

In determining the diameter at the butts of piles, the measurement shall be taken above any enlargement due to the "bell" or swell ends.

Piles shall be treated with 16 pounds of Dead Oil of Coal-Tar Creosote, per cubic foot of pile.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Special Meeting of the Board of Direction, January 25, 1916.

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

Minutes of the last meeting were read and approved.

Ballots for the admission of new members were opened. There were 47 formal and 3 informal ballots. The following were elected:

Resident Members—Robert M. O'Brien, 5315 Camp street, New Orleans; Frank J. Trelease, 912 Fern street, New Orleans.

Non-Resident Members—Fred E. Smith, P. O. Box 146, Baton Rouge, La.

Resident Junior Member—Geo. O. Allain, Jr., 6214 St. Charles Ave.

Transfer from Student to Resident Junior Membership—A. Harold Delbert, 4730 Prytania street, New Orleans; Ralph Earl, 1419 Henry Clay Ave., New Orleans; Edwin J. Fisher, 2316 Camp street, New Orleans; Wilhelm E. Koch, 2627 Coliseum street, New Orleans; Richard B. Kohnke, 2506 Berlin street, New Orleans.

The resignations of Messrs. Donald Renshaw, and M. S. Sloan were laid over to the February meeting.

The report of the Smoker Committee was received and accepted. The report shows the expenses of the Smoker at \$283.65, and assessment on membership \$208.00, leaving a deficit of \$75.65. Mr. Olsen suggested that official thanks be sent to Messrs. Kokosky and Burke for assistance rendered the Smoker Committee. It was moved and carried that the Secretary send an official letter of thanks.

Applications for transfer from Student to Resident Junior Membership from Messrs. Ralph Earl and Chas. Brookshire were passed to ballot subject to approval of Membership Committee.

The following bills were approved for payment:

Jas. Buckley & Co. (engraving) Proc. A/c.....	\$5.00
M. C. Le Jeune (Stenographic Services Proc. A/c November and December)	25.00
Concrete, Subscription, 1916 Lib. A/c.....	1.50
Municipal Engineering Subscription, 1916, Lib. A/c.....	2.00
Electric Journal, Subscription, 1916 and 1917, Lib. A/c.....	3.00
Tulane Press (Letter Heads), Printing A/c.....	5.50
Petty bills for Smoker paid by Ole K. Olsen.....	73.30
Cosmopolitan Hotel (Annual Smoker).....	155.85
Crescent Cigar & Tobacco Co.....	28.10

Tulane University Press (Printing for Smoker).....	13.90
Louisiana Printing Co. (Printing Programmes).....	12.50
Tulane University Press (Printing), Print A/c.....	15.25

There being no further business, the meeting adjourned

W. T. HOGG, Secretary.

Regular Meeting of the Society, February 14, 1916.

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

Minutes of the previous meeting were read and approved.

Professor Gregory stated that the arrangements for entertaining the American Society of Mechanical Engineers were progressing, three papers of local interest were on the program, and he hoped to have something definite to say at the next meeting.

A communication from the American Road Builders' Association was read. The Association has invited the Society to appoint delegates to the Good Roads Congress and Good Roads Show to be held in Pittsburgh, Pa., February 28th to March 3rd.

The technical exercises of the evening were then held. Mr. Frank J. Trelease read a very interesting paper entitled, "Some Structural Features of the Cotton Warehouse and Terminal of the Board of Commissioners of the Port of New Orleans." The paper was followed by a discussion which dwelt mostly on stresses in flat slab construction, and the use of patented types.

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

W. T. HOGG, Secretary.

Regular Meeting of the Board of Direction, February 14, 1916.

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

Minutes of the last meeting were read and approved.

Applications from Mr. J. H. O'Neill, for Resident Membership, and from Mr. Frank Shaw for transfer from Student to Junior Membership, were laid over.

The resignation of Messrs. M. S. Sloan and Donald Renshaw were accepted with regret.

The matter of transferring certain Student and Junior Members to higher grades was referred to the Membership Committee.

The matter of changing several members from Non-Resident to Resident Membership was taken up. The Secretary was requested to inquire of these members if they considered themselves residents of New Orleans or not.

The question of dropping Messrs. _____ and _____, who have not paid any part of their 1915 Dues, was taken up. It was moved and carried that Messrs. _____ and _____ be dropped from the membership.

The report of the Auditing Committee was read and accepted. The report stated that the Committee had examined the books of the Secretary and Treasurer for 1911, 1912, 1913, 1914 and 1915 and found same correct. The Committee earnestly recommended that the books of the Society be audited promptly every year.

The report of the Employment Committee for the year 1915 was read and accepted. The Committee submitted to the Board for approval a plan by which the expenses of the Committee could be met without charging a registration fee. It was proposed by the Committee that an engineer obtaining a position through the assistance of the Committee should pay \$1.00 out of his first month's salary to the Committee for expenses. It was moved and carried that the proposed plan of the Employment Committee be approved.

Financial statements showing the balance in the General Fund and cash on hand February 1, 1916, were submitted by the Secretary. The statements showed a deficit in the General Fund for January amounting to \$43.24, and a standing balance after deducting deficit of \$311.51, and cash on hand after all bills are paid \$848.76.

The following bills were approved for payment:

American Architect, Subscription.....	\$ 8.00
Schumert & Warfield, Ltd., Signatures.....	4.00
N. O. News Co., New Books for Secretary.....	4.75
Tulane University Press, Printing and Postage.....	36.50
W. T. Hogg, Secretary, Salary, Incidentals.....	22.00
There being no further business, the meeting adjourned.	

W. T. HOGG, Secretary.

The Proceedings of the Louisiana Engineering Society

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

DOUGLAS ANDERSON, Editor.

The Louisiana Engineering Society is not responsible for any
statement made or opinion expressed in this publication.

Subscription, \$2.00 per annum

Single copy, 35 cents

ADVERTISING RATES

	ONE YEAR	HALF YEAR	ONE ISSUE
Full page	\$50.00	\$28.00	\$10.00
Half-page	28.00	15.00	6.00
Quarter-page	15.00	10.00	4.00
One-eighth page	10.00	6.00	2.00

For the back outside cover add 50 per cent to the above
rates. For the inside covers add 25 per cent to the above
rates.

Address all communications to
Douglas Anderson, Editor, Tulane University,
New Orleans, La.

LOUISIANA ENGINEERING SOCIETY

OFFICERS FOR 1916

President, SAMUEL YOUNG, 1002 Perrin Building.
Vice-President, A. T. DUSENBURY, 236 Baronne Street.
Secretary, W. T. HOGG, Tulane University.
Treasurer, E. H. COLEMAN, 920 Hibernia Building.

DIRECTORS.

W. B. GREGORY, Tulane University.
OLE K. OLSEN, 822 Perdido Street.
L. C. DATZ, United Gas & Electric Eng. Corporation,
Birmingham, Ala.
R. S. MANLEY, 301 Q. & C. Building.

STANDING COMMITTEES

On Technical Papers

W. B. Gregory
A. M. Lockett
Wm. von Phul

On Library

A. M. Shaw
E. H. Coleman
B. S. Nelson

On Publications—Division "A"

Douglas Anderson
J. M. Robert
W. T. Hogg

On Publications—Division "B"

W. H. Williams
A. T. Dusenbury
R. B. Quincy
John Riess
G. A. Seaver

On Membership—Division "A"

R. S. Manley
James S. Sharp
G. W. Lawes
H. E. Crump
Ole K. Olsen
Chas. M. Kerr
L. H. Guerin

On Membership—Divison "B"

Alfred Raymond
T. L. Willis

On Employment

H. Kokosky
Chas. J. Hardy

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

All business communications should be addressed to W. T. Hogg, Secretary,
P. O. Station 20, New Orleans, La.

National Defense and International Peace



What the Engineers are Doing

THIRTY thousand American engineers are making a card index survey of American industry so that it may be prepared for its vital part in defending the Country, if need comes. The past eighteen months have taught us here in America what lack of industrial preparedness has meant to some of the countries now at war. These nations had the ships and they had the men; but when the hour struck, their factories were not able to furnish the colors with arms and shells and powder. Their factories were not prepared. And our factories are not prepared.

But it is not enough to draw a moral. In the United States five great Engineering Societies — Civil, Mining, Mechanical, Electrical and Chemical — have pledged their services to the Government of the United States, and are already working hand in hand with the Government to prepare industry for the national defense. They receive no pay and will accept no pay. All they seek is opportunity to serve their country, that she may have her industries mobilized and prepared as the basic line of defense.

All elements of the nation's life — the manufacturers, the business men, and the workingmen — should support this patriotic and democratic work of the engineers, and assist them cheerfully when asked. *There can be no better national insurance against war.*

The Associated Advertising Clubs of the World, representing all advertising interests have offered their free and hearty service to the President of the United States, in close co-operation with these five Engineering Societies, to the end that the Country may know what the engineers are doing. The President has accepted the offer. The engineers have welcomed the co-operation.

This advertisement, published without cost to the United States, is the first in a nation-wide series to call the country to the duty of co-operating promptly and fully with the Engineers to prepare industry for

Naval Consulting Board of the United States in Co-operation with The American Society of Civil Engineers. The American Society of Mechanical Engineers. The American Institute of Mining Engineers. The American Institute of Electrical Engineers. The American Chemical Society.

Engineering Societies Bldg., 29 West 39th St., New York City

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. II

JUNE, 1916

No. 3

CONTENTS

FRONTISPIECE:

EDITORIAL, NOTES AND COMMENT:

PAGE

Industrial Preparedness	127
Spring Meeting of the A. S. M. E.	130
Our Society	134
Technical Papers in this Issue	136
Discussion on Mr. Trelease's Paper	137
Again the Problem of Flood Control	137
New Members	138

BOOK REVIEWS	139
--------------------	-----

PAPERS AND DISCUSSION:

Industrial Resources of Louisiana. <i>By C. W. Williamson</i>	141
Hurricanes. <i>By Dr. I. M. Cline</i>	157
Grouting Process Used in Closing Cracks in Reinforced Concrete Canal. <i>By Alf. G. Théard</i>	164
Flood Conditions at New Orleans as Affected by the Divorcement of the Atchafalaya and Mississippi Rivers. <i>By J. P. Kemper</i>	168

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY	174
---	-----

EDITORIAL NOTES AND COMMENT

Industrial Preparedness.—As a part of our contribution towards the propaganda for National Defense and International Peace, we are publishing in the front of this issue the statement of the Naval Consulting Board of the United States. This movement on the part of the engineers of the country, lending their services voluntarily and without charge to the government, for the purpose of making an industrial survey of the resources of the country, shows a most commendable spirit of patriotism. There are many lessons to be learned by the neutral nations in this great international conflict, but of them all none is of such importance as that of industrial preparedness. Because, as has been amply exemplified in the case of

one of the belligerent nations industrial preparedness spells preparedness for almost any emergency, even for that most terrible of all emergencies, war.

Whatever one may think of the motives which actuated Germany in starting the present war, one cannot but admire the excellent and efficient state of preparedness with which she went into it. And if the conditions of this preparedness be looked into with care it will be found that the preparations for war, which were so adequate when war came, were a part of the great national system of general industrial preparedness, for which Germany has always been justly celebrated. No amount of natural resources will be of much avail to a nation in the stress of war unless she has developed adequate means for converting these resources into the munitions of war. And as has been so clearly proven in the case of Germany, a nation which makes a careful and scientific study of the problem of utilizing to the fullest extent its natural resources, is at the same time doing the best possible thing towards preparedness for war when it does come. Or, as has been said in many different forms, if we are thoroughly prepared for war, then are we still better prepared for peace.

Another striking lesson to be learned from the present conflict is that it is a war of scientific and engineering appliances and skill. The engineer has played an important part in the preparations for war and is now playing a large part in the conduct of it, both on the actual field of battle and at home in the organization and efficient operation of the many industries which must be kept working at full capacity in order to furnish the soldier in the field with the many articles necessary for his proper equipment.

This movement, therefore, on the part of the engineers of the United States appears eminently fitting and proper, for if war should come they will be called upon to play an important part, and the industrial survey which they will have furnished the government will be of the very greatest service in the problem of securing an adequate supply of the munitions of war. Should war not come, as every engineer sincerely hopes it will not, this survey will be equally as valuable, if not more

so, as a broad foundation for the development of a spirit of co-operation and mutual assistance in the problem of utilizing to the fullest extent the great natural resources of this country.

The paper on the Industrial Resources of Louisiana by Prof. C. W. Williamson, published elsewhere in this issue, has a specially timely value in connection with this very subject of industrial preparedness. While Louisiana is generally looked upon as being a rather strictly agricultural state, yet her mineral resources are some of the most extensive and valuable in this country. She has particularly a vast supply of the type of resources which lend themselves readily to the most modern methods of chemical manufacture, and with cheap power in the form of electricity generated by means of oil engine prime movers she would seem to offer an exceedingly attractive field for this form of industrial development.

A significant sign of the times among the engineers in this country is the fact of the great awakening on the part of individuals as well as on the part of local and national societies to a sense of their responsibility as citizens in the matter of co-operation with municipal, state and national government in the solution of the many technical problems which are constantly coming up. The engineer, as a rule, has been contented to confine his activities to the purely technical features of his work, and to keep himself more or less in the background, leaving the discussion of matters of policy and financial arrangements to the lawyer, the business man and the professional politician. In Germany one finds quite a different condition of affairs. First of all the professional title of "Engineer" is much more jealously guarded and protected than it is in this country, where the term may mean anything from the man who fires the boilers in a department house to the man who can design and build a Brooklyn Bridge or a North River Tunnel. Furthermore the engineering profession in that country will be found to be one of great prominence, the advice of whose members is eagerly sought after in connection with general problems of finance, of municipal government and of national policy.

Affairs are tending that way in our own country, and the more nearly the engineer approaches to a realization of himself

and his importance in the community, the more nearly will the country as a whole attain to that condition of industrial preparedness which now appears to be so desirable and necessary.

The organization of the Naval Consulting Board of the United States forms an interesting illustration of the trend of affairs discussed above. It is under the general direction of this board that the engineers of the country are now carrying out the industrial survey as a part of the general plan of industrial preparedness.

The Naval Consulting Board is being assisted in each State by associate members who have been nominated by the different National Societies and appointed by the Secretary of the Navy. The members for Louisiana are:

American Society of Mechanical Engineers, A. M. Lockett.

American Society of Civil Engineers, Arsene Perrilliat.

American Chemical Society, W. L. Howell.

American Institute of Electrical Engineers, M. S. Sloan.

Spring Meeting of the A. S. M. E.—The following extracts from the report of this meeting recently held in New Orleans, published in the May number of the official journal of the American Society, will be of interest to those of our members who are not members of the Society of Mechanical Engineers.

“The Spring Meeting at New Orleans, with headquarters at the Grunewald, was successful from every standpoint. The local membership of the Society, the Association of Local Members of the American Society of Civil Engineers and the Louisiana Engineering Society joined as hosts, and arrangements were perfectly worked out through their local committee, W. B. Gregory, *Chairman*; A. L. Black, *Treasurer*, and H. L. Hutson, *Secretary*.

“The engineering developments of New Orleans in connection with its drainage problem, sewerage disposal and water supply and the handling of its freight for foreign shipment, are of unusual interest. The old town of New Orleans, which still reflects the characteristics of the French and Spanish who were the first settlers, is an alluring place for visitors, and dinner parties at the noted restaurants in this section were very much

in order during the convention. Most of the historic buildings, sights and landmarks are to be found here and their proximity to headquarters made possible frequent between-time trips to this almost foreign land."

"The attendance was good considering the great distance from the center of gravity of the Society's membership, there being a total registration of 485, of which 114 were members, 92 of whom were from out of the city."

"The first session on Wednesday morning, April 12, was opened by Chairman W. B. Gregory of the local committee of arrangements, whose cordial welcome made those present doubly glad that they could be there to enjoy the hospitality in store for them. Professor Gregory referred to two early and distinguished members of the Society who were claimed by New Orleans. Lewis Johnson, a charter member, remembered with affection and esteem, lived his life and died in New Orleans. For many years he was president of the Sewerage and Water Board of the city, and chairman of the Executive Committee. The work of the Sewerage and Water Board stands as a monument to his memory. The city has been transformed as regards sanitation and drainage, and has been given an abundant water supply."

"The other name, high on the honor roll of the American Society of Mechanical Engineers, is that of Maunsel White, a native of Plaquemine Parish, below New Orleans. He will be remembered for his part in the extensive investigations which led to the discovery of the Taylor-White process of treating steel, and the development of high-speed steel, revolutionizing the machine shop work of the world and doubling and trebling the output of machine tools. He was a man of wide interest, who loved literature and art, a poet and mathematician. Mr. White died in New Orleans in 1912."

Following Professor Gregory, A. M. Shaw, Past President of the Louisiana Engineering Society, welcomed the visiting engineers as a representative of the Louisiana Engineering Society and of the local association of members of the American Society of Civil Engineers."

"The Chairman then introduced Hon. Martin Behrman, Mayor of the city of New Orleans, who recounted briefly the long struggle of the city to solve its problems of sanitation, water supply and shipping facilities."

"President Jacobus responded and afterwards took the chair for the session which followed on Organizing for Industrial Preparedness. It had been his privilege to arrive early in New Orleans and to attend a meeting of the Louisiana Engineering Society. Prof. C. W. Williamson presented a paper on the Industrial Resources of Louisiana which had a direct bearing on the subject of the morning's discussion. There was also a Spring Meeting paper by William von Phul on the facilities of the Port of New Orleans. These two papers, and the remarks by the speakers of the morning, indicate the importance of New Orleans and of Louisiana as an industrial and an engineering center. Tulane University of New Orleans and the State University at Baton Rouge both contribute to this end. The engineers of New Orleans are to be congratulated on the commercial promises of the city and the features which are bound to make the locality a center of engineering; a movement in which all will wish to coöperate, since engineers in fact are all brothers, and wish to pull together for the best success of all concerned."

"It was the intention of the Committee on Meetings that, following the session on Wednesday morning, the local committee of New Orleans should be given the balance of the day and the whole of Thursday to carry out such plans as they had arranged for. Accordingly, the session on Thursday morning consisted of papers on local subjects by local engineers, and Wednesday and Thursday afternoons and evenings were devoted to various entertainment features."

"On Wednesday afternoon there was a trip on the steamer Sidney to inspect the harbor of the Port of New Orleans formed by the Mississippi River. There are many miles of water front controlled by the Board of Port Commissioners as representatives of the State of Louisiana, and the docks and warehouses, totaling nearly 20 acres in area, are uniformly of most modern construction with mechanical handling devices, as, for example, for the unloading of bananas, one of the chief imports, for

which specially designed conveyors are used. The exports and imports through the port of New Orleans are valued annually at over \$300,000,000."

"During the trip a landing was made at the recently constructed public cotton warehouses erected at the expense of \$3,000,000 for the safe storage and shipment of cotton. This not only provides the best possible facilities for handling at low cost, but the large storage capacity enables the cotton to be handled at the most advantageous time in relation to the market conditions."

"Many interesting facts about the harbor and the cotton warehouse were brought out in the lecture by Commissioner W. B. Thompson, given in the evening, on the Debt of New Orleans to the Engineer. Mr. Thompson's address was carefully prepared, pleasingly delivered, and gave the visitors a most acceptable resumé of the striking engineering developments of New Orleans which have meant so much in the city's growth and for which the city is indebted to the engineer as its master worker."

"Several clubs of New Orleans, including the New Orleans Country Club and the Chess, Checkers and Whist Club, extended their club privileges to the members and on Thursday afternoon as many as desired to go were taken in automobiles to the Country Club, one of the beauty spots of the city, which, unlike most such outdoor places, is located near the center of the city and conveniently accessible from almost any point. From here the party went to the Newcomb School of Art, a department of Newcomb College, the woman's college of Tulane University, where many beautiful art objects are made by the students under the personal direction of their instructors. The Newcomb pottery, which is widely known as ranking among the most attractive products of the potter's wheel, is made and decorated here with designs characteristic of the Southern flora, rich and beautiful in its subdued tones. The visitors were graciously received at the school by the ladies of New Orleans and the students of the college. Tea and refreshments, including New Orleans candies, were served, and the college Glee Club afforded entertainment."

"On Thursday evening was the culminating feature in the reception and dance held in the ballroom of the Grunewald, which was largely attended and greatly enjoyed."

"On Friday afternoon a party was taken to the New Orleans Lake Shore Land Company's project to inspect the reclamation work in process there. This trip was of interest for other as well as its engineering features, because the tract is devoted to the growing of oranges."

"Probably a third of the visitors remained for the day Saturday to continue their trips about New Orleans and on this day as well as previously, many took occasion to inspect some of the most interesting municipal plants, including the water filtration and pumping plant, and certain of the drainage pumping stations."

To the above quoted extracts from the Journal of the American Society it only remains to express, on behalf of the Louisiana Engineering Society, the great pleasure which all of its members felt in doing their share toward the entertainment of the visiting engineers. They were a very representative group of men, coming from all parts of the country, and their visit to New Orleans will long remain a pleasant memory in the minds of those of our members who were so fortunate as to be able to attend the various sessions of the Convention, and to take part in the social functions arranged for their entertainment.

Our Society:—The following statement of the organization and purposes of the Louisiana Engineering Society was prepared by President Young for the Conference on Engineering Coöperation, held at Chicago, April 13-14, 1916. It is republished here not only for the interest it may have for our present members, but for the influence it may have in securing new members for the Society:—

The Louisiana Engineering Society was founded in 1898, with a charter membership of 25.

Some of the motives which actuated those engineers who organized the Society were: a desire for a more comprehensive use of engineering literature, to be made possible by a combi-

nation of resources for that purpose; a sense of the advisability and the desirability of uniting for the promotion of better acquaintance and better understanding among the engineers of the State, with a view to a broader and a more useful interchange of ideas on engineering subjects; a general desire to build up a stronger feeling of good-fellowship and cordiality among the engineers of the community, embracing all branches of the profession.

The results accomplished have probably surpassed the anticipations of the founders and, to say the least, the present outlook is encouraging.

During the eighteen years of its existence, the Louisiana Engineering Society has grown steadily, both in numbers and in its sphere of usefulness to the engineering profession. There are unmistakable signs of growing interest and loyalty on the part of the members, which, after all, are the best indications of healthy growth and real progress.

During the first year or two, the average attendance at the meetings was not more than ten or twelve, and often not even a quorum was present. It was difficult to secure technical papers for the meetings.

The present membership is about 250, and it is not unusual to have an attendance of 50 or 60 at a meeting. Meetings are held monthly, except during the months of July and August, and it is comparatively easy to secure a technical paper for every meeting. The Society provides light refreshments after every meeting, and by this means the members are kept together for twenty or thirty minutes of informal, friendly intercourse.

The Louisiana Engineering Society joined The Association of Engineering Societies in 1898 and maintained membership in that Association until the end of 1914, at which time this Society withdrew and began the publication of its own journal, known as "Proceedings of the Louisiana Engineering Society." The publication of this journal has been successful far beyond first anticipations, and present indications are that it will be an important factor in the future growth of the Society.

It was through the influence of the Louisiana Engineering Society that the Louisiana State law for licensing engineers and surveyors was enacted. While this law is not nearly perfect, or what the engineers, who were its sponsors, desire, still it is believed to be a step in the right direction and the best compromise that could be effected at the time.

The Society now has a fairly good engineers' working library, and this is being gradually improved through an annual expenditure of about \$700.00. Headquarters are located in one of the historic buildings of the old Spanish Cabildo group, now occupied as a State Museum of Natural History. A room to house the library and to serve as a place of meeting has recently been fitted out by the Society at a cost of about \$900.00. The Society's finances are apparently established on a sound basis.

The membership is representative of the various branches of the engineering profession and, to a limited extent, embraces the contracting business. All are working together in harmony and for mutual benefit and advancement.

Such an organization could hardly be other than an uplifting influence in the community where it is domiciled.

SAM'L YOUNG, President.

Technical Papers in This Issue.—This number of the *Proceedings* contains, in addition to the principal paper on Industrial Resources of Louisiana by Professor C. W. Williamson, two shorter articles of very considerable interest. One of these is the report of a lecture on Hurricanes delivered by Dr. I. M. Cline at the regular meeting of the Society, March 13, 1916. When Dr. Cline speaks on matters connected with weather conditions in the Gulf Coast States, he speaks as one with authority, and it is always a source of much pleasure and instruction to hear him. This lecture was of special interest because of the scientific explanations and description of the great hurricane of September 29th.

The other paper is a contribution by Mr. Alf. F. Théard and contains a very interesting and instructive description of

an emergency method of closing up some cracks which appeared in one of the reinforced concrete canals of the New Orleans drainage system.

The Editor must be excused if he shows a tendency to harp too much on one subject, but this paper of Mr. Théard is a good illustration of the sort of contribution which we are anxious to secure for the *Proceedings* in increasing numbers. There must be many examples in this city and community of work such as this which if properly written up would make a valuable contribution to the engineering literature of this section.

Discussion of Mr. Trelease's Paper.—Mr. E. Hunter Coleman has submitted the following discussion of the paper by Mr. Trelease which was published in the April issue of the *Proceedings*—

“I read the paper by Frank J. Trelease on the Cotton Warehouse with a great deal of interest. He mentions the fact that these buildings were designed for a wind load of 30 pounds to the square foot, and remarks that they were not damaged in any way by the storm of September 29th. In this connection would say that the Pumping Station of the Jefferson and Plaquemines Drainage District, which is of mill building type, was designed for a wind pressure of 10 pounds to the square foot and the resultant stresses reduced 25%, three-fourths of the wind load assumed as carried in the windward column. While this building, not being in as exposed a position as the Cotton Warehouse buildings, was not subjected to quite as high a wind pressure, nevertheless it was not damaged at all, which would seem to indicate that the 30 pound wind pressure recommended by most Building Codes and specifications is excessively high.”

Again the Problem of Flood Control in the Mississippi River.
—Mr. J. P. Kemper contributes to this issue of the *Proceedings* a short paper containing a further discussion of this much-

discussed problem. This paper concerns itself particularly with the question of the divorcement of the Atchafalaya and Mississippi Rivers and the consequent effect upon flood conditions at New Orleans. The Editor does not feel competent in any way to pass upon the merit of the ideas advanced in this discussion, but there is one general point made by Mr. Kemper which appears to him reasonable. That is, it does not do to fall back upon the statement that the Mississippi River is a law unto itself and that there are no formulae or principles which may be used to predict or estimate its future behavior. In all the years of study which have been devoted to this problem there must of necessity have been developed constants and empirical data which when properly applied to the fundamental principles of hydraulics will give at least an approximate answer to the important question as to what is going to be the ultimate result of the adherence to the policy of levees only, so-called. And furthermore it seems reasonable to assume that the men who have given all their lives to the practical solution of this problem, and to the work of securing these data and constants, would be the ones best qualified to apply them to the fundamental principles. It would appear therefore that a reasonably definite answer could be given to Mr. Kemper's question.

New Members.—Since our last issue the following new members have been elected to the Society, and it gives us great pleasure to welcome them into our midst—

RESIDENT MEMBERS.

David L. Cullom, 3629 Baronne St., New Orleans.
John H. O'Neill, 936 Arabella St., New Orleans.
Adam J. Haaser, 715 Oliver St., New Orleans.

TRANSFER FROM JUNIOR TO RESIDENT MEMBER.

Thomas White, Southport, New Orleans.

ASSOCIATE MEMBER.

J. M. Vanderveer, New Orleans.

NON-RESIDENT JUNIOR MEMBER.

Frank Roger Duvie, care U. S. S. Lake Brogne, Natchez, Miss.

TRANSFER FROM STUDENT TO RESIDENT JUNIOR MEMBER.

John A. Brookshire, Jr., 1217 St. Roch Ave., New Orleans.

Frank Russell Shaw, 4481 De Montluzin St., New Orleans.

BOOK REVIEWS.

Industrial Leadership. By H. L. GANTT. Pp. xii + 128.
Yale University Press, New Haven. 1916. Price \$1.00
net.

This little volume contains a series of lectures in the Page Foundation delivered in 1915 before the Senior Class of the Sheffield Scientific School, Yale University. Mr. Gantt is a well-known authority on scientific management, and this series of lectures deals with some of the broader problems and fundamental principles which must be understood by one who desires to apply with success the details of such management to any business enterprise.

Mr. Gantt takes the position that democracy, in order to compete successfully in the matter of industrial efficiency with autoocracy, must be able to develop methods of organization and administration which will be able to accomplish as much at least as has been done in the past by autoocracy.

There are five chapters, dealing respectively with the subjects: Industrial Leadership, Training Workmen, Principles, Results of Task Work and Production and Sales. The book is interesting from cover to cover and would make profitable reading not only for the engineer and manager, who are in such constant and intimate contact with their employees, but also to the average man who wishes to be informed as to the principles which must prevail if the industrial development of this country is to attain to the same high plane of efficiency that has been reached in certain of the central European nations with autoeratic forms of government.

A quotation from the chapter on "Training Workmen" will be of interest as illustrating the author's point of view in this connection:

"It is imperative, therefore, in seeking the proper industrial methods to bear in mind the fact that the *men produced by them are far more important to the life and prosperity of a nation than the wealth and luxury by which we set so much store*. We, as a nation, have been accused, and with a certain degree of justice, of putting the almighty dollar before everything else. One of the objects of this lecture is to make clear that there is something in the world not only higher, but more powerful than money."

D. A.

PAPERS AND DISCUSSIONS

INDUSTRIAL RESOURCES OF LOUISIANA.

By

C. S. WILLIAMSON, JR.,

Associate Professor of Industrial Chemistry in Tulane University.

(Read before the Society, April 10, 1916.)

The shutting off of certain supplies necessary to our peaceful commerce, by the engagements on the other continent, has brought out the fact that we are not economically independent of the good will and ability of other powers to deliver, although possessed of natural resources in abundance, and have able chemists, engineers and scientists, who are ready and willing to assist in whatever development should take place. It has also brought out, that our lack of economic independence is occasioned by the lack of certain industries necessary to provide the chemicals and products of manufacture required by certain industries already existent and dependent in their operation upon these chemicals and products, and further that there has not been a distribution through the country geographically of those industries already developed.

On the other hand, since the outbreak of the war, a stimulus has come to industrial manufacturing, industrial development, and industrial research, the results of which have placed us in a better strength economically, but sufficient development has not taken place to insure those industries absolutely necessary to our independence, and absolutely necessary for the safety of the nation, in time of her own peace but war of other nations, and in time of the distress of war that is likely to come to any country.

At the outset of the European conflict, we had in the United States six dye-stuff manufacturing plants producing annually an aggregate of 3,300 short tons of dyestuffs, while the importations amounted to 25,000 short tons, 22,000 of which came from Germany. Our total consumption aggregated annually 29,000 short tons. The establishments in the United

States using dye-stuffs number approximately 14,429, having a capitalization of about \$3,141,263,989, and employing 1,387,201 men and women as workers. There are also a number of smaller establishments not included in this estimate which will aggregate the total to 2,000,000 employees. Before twelve months of the war had passed our dye-stuffs industry had doubled itself. Today we have fourteen plants producing finished dyestuffs, seventeen producing crudes and intermediates, and our annual output of colors is 15,000 short tons from American coal tar. Before the beginning of the war we imported 2,500 short tons of anilin oil and anilin salts, but before the close of 1916 we will produce 11,000 tons of anilin and anilin salts on American soil from American coal tar. Toluol, benzol, and anilin are being produced in large quantities by the Standard Oil Company, the Benzol Products Company, and others, while phenol is produced synthetically by one plant at the rate of 6,000 pounds per day. The approximate output per month is distributed as follows: benzol, 7,500 short tons; toluol, 1,870 short tons; xylol, 950 short tons; napthalene, 12,500 short tons; and phenol, 10,000 short tons.

A large portion of these compounds (which are the starting points for either the manufacture of dyes or explosives), is at present utilized for the manufacture of explosives, but the fact, that they are being produced at an increasing rate, and that they are useable for the manufacture of compounds for either peaceful or belligerent purposes, deserves note, and may well encourage us, that we are capable of enlarging our industries in these lines, and are on the way of being able to meet an emergency should it arise, needing only to have kept before us a stimulus sufficient and an encouragement adequate to insure development commensurate with the demands.

Within the past year or two other important advances have been made in the field of industrial chemistry, to which we may point with pride, as demonstration that we are capable of advancement and self containedness, instead of being dependents on the works of scientists of other countries.

Rittman, in his work on the "cracking" of petroleum oils, shows, that he is able to increase the output of gasoline oil by 16

per cent from petroleums yielding originally 5 per cent of this oil. Also that he is able to increase the content of aromatic compounds by 8 per cent, which compounds are those necessary for the manufacture of both dyestuffs or explosives.

The process of McAfee for splitting high boiling point petroleum oils into low boiling petroleum oils, by distillation in the presence of aluminum chloride as a catalyst, may substitute the unsatisfactory and dangerous process of cracking.

The work of Kalmus, Harper and Savell on electroplating with cobalt instead of nickel is important, both from the standpoint of the character of plate produced and the concentration of solution allowable, hence the rapidity of plating.

The production of zinc electrolytically direct from the ore has been accomplished, at Great Falls, Mont., by the Anaconda Copper Company, on a sufficiently large experimental basis to warrant the company commencing the construction of a plant with an annual output of 35,000 tons of electrolytic spelter.

Laboratory porcelain and glassware have been imported almost altogether previously, but the industry has advanced rapidly in the States within the past eighteen months, although it is in more or less of the experimental state as yet.

Optical glass, which is so necessary to medical work, biological work, and to the operation of armies and navies, is now being manufactured by the Bausch & Lomb Optical Company of Rochester, N. Y.

Potash compounds, upon which scientific agriculture and successful farming greatly depend, which as we are all aware come practically entirely from Germany, may be produced in this country from materials at hand. Already one plant, for the production of potassium sulphate in the quantity of 20 tons per day from alunite, is in the process of construction and almost completed. The work of Cushman and Coggeshall, on the production of potash from feldspar, deserves most commendable credit, and should have the attention of the fertilizer industry.

The new process for the production of metallic magnesium by electrical methods is received with applause, on account of its use for scavenging alloys, of its property of alloying itself with aluminum and other metals, to say nothing of its use for shrapnel

trailers, star bombs, flare lights, and flash lights in photography.

Although these instances cited evince progress in industrial research, and developments cited in other lines show progress, we are lacking some of the most important industries and developments, which are almost imperative at present, and would become imperative, if by any chance we found ourselves suddenly shut off from our present supply. It seems almost mandatory that a realization of this fact should take place, which would be the case, if the facts were looked upon as facts themselves, and not as excited or fancied expressions of some one who has an interest to forward by acclaiming such conditions, and if the expressions and statements of those engaged in and concerned with industrial work, who are acquainted with the needs and possibilities of the industries were analyzed and assimilated. Our country is possessed of natural resources, doubtless sufficient to provide all our needs in peace or distress, and invested with a body of chemists, engineers, and scientists able to guide the development of these resources.

In addition to our dependence on the good will and ability of other nations to deliver essential chemicals for peaceful purposes and for manufacturing explosives in case of the distress of war, the development of our industries, which supply a portion of these essentials, at present, has taken place in one small portion of the States, so that the manufacture for distribution to other parts of the Union is confined to a limited area. It is evident that the segregation of those industries is not because the major portion of the raw materials is found in that limited area, for as a matter of fact, some of the finished products put out from that section are produced from raw materials from a wholly distant location, and call for the shipping of these raws to that section and the reshipping of the finished products to the district from whence the raws.

The question of nitrogen supply in a useable form is vital to any nation from the food standpoint, as evidenced by the famines of Russia, China and India, which were nitrogen starvations. Further than this, the necessity of available nitrogen for various manufacturing purposes, among which may be espe-

cially mentioned the dye-stuffs and explosives, and for agricultural fertilizers is imperative to any nation.

With the exceptions of a small portion of the ammonium sulphate and the major portion of nitrogenous organic refuses, we are importers of available nitrogen used in agricultural practices, in manufacturing dyestuffs, and producing explosives for both engineering construction work and explosives of war, and in other manufacturing processes.

The importations of nitrogenous materials in the crude form previous to the present war was distributed as follows:

Sodium Nitrate.....	\$17,660,000
Ammonium Sulphate.....	4,416,000
Calcium Cyanamide.....	1,590,000
Various other nitrogenous fertilizers.....	5,464,000
TOTAL	\$29,130,000

Our annual consumption of ammonium sulphate was 265,000 short tons, of which we produced 75,000. Our annual consumption of sodium nitrate was 610,000 short tons and of cyanamide 33,000, all of which are imported. Our annual consumption of organic nitrogenous materials was \$20,300,000, of which we import \$5,500,000 worth.

In addition to these we import nitrogen in the form of refined chemicals, dyestuffs, explosives, celluloid, prussiates, cyanides, nitrates, collodion, etc., to the value of \$12,500,000, thus summing up a total of \$42,000,000 per year paid to foreign interests for the nitrogen, which is so highly essential to our welfare for agricultural purposes, for explosives, for dyestuffs, and for other products of chemical manufacture. In round numbers our nitrogen consumption under normal conditions aggregates \$73,000,000, of which we produce \$31,000,000, leaving a deficit of \$42,000,000.

Our coal distillation industry, amounted in 1913 to 75,000,000 tons of coal distilled, producing 800,000 tons of ammonium sulphate, of which was recovered 195,000 tons, meaning a loss of \$38,000,000 in ammonium sulphate alone, to say nothing of other products that went off with the sulphate. If this industry

were developed to recover the ammonium sulphate, and if our fertilizer industries expanded to increase the output of organic nitrogenous materials, thereby producing the required amount of nitrogen for consumption in agriculture and manufacturing, we would lack having it in the essential form required for both our dyestuffs and explosives industries, and many other processes. With the exception of a small experimental plant at Nitrolee, S. C., having a capacity of four tons of nitric acid per day, we are without a plant in the United States exclusively for the production of nitric acid by synthetic methods, either by the oxidation of nitrogen from the atmosphere to oxides of nitrogen and further conversion to nitric acid, or by the decomposition and oxidation of ammonia, though a few plants devoted to other processes have small units. These processes are well developed on the European side, Germany having spent \$100,000,000 for the expansion of her nitrogen industry since the outbreak of the war. Although the production of nitric acid synthetically had its first commercial development by Bradley and Lovejoy on American soil, our production is wholly from Chilean nitrates. The importations of Chilean nitrates into the United States amounts to about one-fifth of the total production at the mines in Chile, seventy-five per cent of which importation is utilized in the manufacture of explosives and nitric acid. Further than this, if we resorted to the production of nitric acid from ammonia, utilizing calcium cyanamide as our basis for ammonia, we do not produce a pound of cyanamide on the United States side, but are dependent upon the cyanamide plants on the Ontario side of the Falls. If not from this source, the synthetic production of ammonia could be relied upon, provided, we had in operation a synthetic ammonia plant, but we have not a plant operating the Haber process, which has been developed and proven a commercial success by the Badische Anilin und Soda Fabrik, nor could one be erected under twelve to eighteen months and put into operation. Faced with the facts, that nitric acid is the means to every explosive and every dyestuff from coal tar, that we have not a single plant of any consequence in the States, and that plants of sufficient magnitude to meet our requirements could not be sprung up on a moment's notice, we may conclude

the result if we were suddenly cut off from our present source,—Chile.

A second fact brought to light by a study of our industries, is, that our explosives and ammunition plants are located in a narrow strip on the Atlantic, 200 to 300 miles in length, extending from Massachusetts to Virginia, and less than 100 miles interior from the coast. With the exception of one plant at Cincinnati, and one recently constructed in Pennsylvania, there is not a plant of any consequence for the manufacture of explosives west of Philadelphia, and the one furthest south is only a short distance from Richmond, Va. Of our Government manufacturing arsenals, we have two in Massachusetts, one just above Albany, N. Y., one at Philadelphia, and one at Rock Island Arsenal, Ill., on the Mississippi River. We have a distributing and repair arsenal at Benecia, California. We have one army powder factory in Northern New Jersey, one naval powder factory twenty miles south of Washington on the Potomac, and one gun factory at the Navy Yard (Washington).

The large private munitions plants of the States are located in Massachusetts, Connecticut, New York State, Pennsylvania, New Jersey, and one at Cincinnati. Smaller plants are in operation at other points, and there are a number of small mixing plants, that have gone up since the outbreak of the war, which could hardly be counted in making an inventory of our ammunition resources.

Yet another fact significant in itself, is the steel and iron situation, with reference to development. For the year 1915 there were produced in the United States 55,000,000 gross tons of iron ore, 85% of which came from the Lake Superior region, ninety-five per cent of the steel of the United States being produced from this. Of the 55,000,000 tons of ore utilized in the States, 46,310,000 tons came by water through the canal at Sault Ste. Marie from the Lake region, the other 8,700,000 coming from other mines of the States, except possibly 1,000,000 tons, which came from the Lake region by rail.

The development of our Southern iron ore deposits and Southern iron and steel industry, along with other sections,

would give us greater assurance of an adequate supply from some other source than that located on the border of at present a friendly nation. The value of our Southern ore beds is well known, and it is further well known that as good steel can be produced from Southern ore as from any other of the States.

Of the natural resources of Louisiana, those which may be classed as suitable for manufacturing and refining, embrace minerals and mineral products, wood and timber, cotton, cotton seed, sugar cane, rice, and others of minor importance.

Other resources, which themselves are potent on their own merit and doubtless have manufacturing possibilities, are the fish, oyster, and fur businesses. During 1915 the values for the buffalo and catfish alone amounted to \$1,000,000; that for oysters \$6,000,000, which is more than all the States of the Union combined; and for furs \$2,000,000. The shrimp production of Louisiana comprises 75 per cent of the production of the United States.

Louisiana has a coast line of 1,000 miles, has 4,700 miles of interior navigable waters; in timber valuations its stands second among the States, while it has the largest standing body of yellow pine in the United States, the estimate placed by the Forestry Bureau on hard woods being 36,400,000,000 board feet.

The mineral production of Louisiana amounts annually to \$25,000,000, this estimate being on the amounts actually put out and not on amounts marketed as refined products. Of this \$25,000,000, crude oil represents \$12,000,000; natural gas, \$2,000,000; salt, \$200,000; sulphur, \$7,500,000; the remaining \$3,300,000, by clays, sand, gravel, stone, etc.

Particular attention may be drawn to petroleum and natural gas on account of the fuel values of each, but additionally attention may be called to petroleum because of the possibilities for manufactured products. According to the 13th Census reports, Louisiana is underlain by 470,000 acres of crude oil, from which were operating 800 wells, and there is every reason to believe that there is underlying one of the largest gas deposits in the States. Natural gas is supplied to thirteen towns and villages of the State, to towns in Texas, and to towns in Arkansas as far north as Little Rock. There is reason why natural gas should be

brought to New Orleans . . . *the development of industries that would accompany this fuel that it is so admirably adapted to.* For instance New Orleans sand is shipped to Shreveport for the manufacture of glass. The heat value of Louisiana petroleum ranges from 18,000 to 20,000 B. t. u. per pound, and for natural gas is around 1000 B. t. u. per cubic foot. In addition to the fuel value of natural gas, gasoline of 75 to 98 Baume may be condensed from natural gas ranging from 0.95 to 1.60 specific gravity, to the extent of one to five gallons per thousand cubic feet. Petroleum of Louisiana is of two varieties, (and possibly the third) that of asphaltic base and that of paraffinic base. It is a source of crudes and intermediates for the dyestuff industry, this being especially worth notice since the work of Rittman referred to above. Equally as important would it be from the standpoint of explosives, since the same crudes and intermediates that are used for dyestuffs are used for explosives.

As a source of fuel for development of electrical power, the field is inviting to investigation, since it is reported by one of the leading engineering firms of this city that at one place in the State power is being produced at a cost of 4.3 mills per K. W. H., by a 300 H. P. oil engine installation, direct connected, and operating on less than one-half a pound of oil per brake horse power hour. (This figure was based on the cost of oil at 75 cents per barrel, which it was at the time of the statement). This opens an especially interesting field for estimates from the fuel value standpoint, since the production of many of our chemicals is through the use of electric energy. Among these may be mentioned caustic soda, chlorine, bleaches, metallic aluminum, carborundum, calcium carbide, calcium cyanamide, nitric acid, ammonia, chloroform, iodoform, hydrogen, oxygen, phosphorus, carbon disulphide, and others.

As a producer of salt Louisiana ranks fourth in the States, while in amount of deposit she ranks second in the world. The deposits of crystal salt occur on the so-called five islands, developments on two of which have taken place, mining being done at a depth of 500 feet, the purity of the product ranging from 96 to 99.9% sodium chloride. Other salt sources of the State are the north central portion and north portion of the State in the

valley of the Red River and its tributaries. It is reported that the production of salt for 1915 aggregated 300,000 tons.

Equally as important as petroleum for industrial chemical manufacture is salt, for, it like sulphur, is a basic chemical for almost every chemical industry. Without these two basic chemicals (salt and sulphur) the petroleum resources of Louisiana would not be so potential, when viewed from the refiners' standpoint, or when looked upon for dyestuffs and explosives, for these two industries call for heavy chemicals made from salt and sulphur. Products which are derivable from salt are caustic soda, chlorine, bleaches, soda ash, cooking soda, Glauber's salt, etc. With the advent of cheap electric power the first three of these are made possible, while the others may be developed along with these.

The valuation of Louisiana's sulphur deposits is inestimable. Of the production for the whole United States the major portion is produced in Louisiana. It is reported that the production for 1915 was about 400,000 tons, which valued at \$20 per ton amounts to \$8,000,000. Louisiana controls the sulphur market of the world, although it is mined at only one place in the State. The purity of the product is 99.8% elemental sulphur, which form of sulphur is admirably suited to the manufacture of sulphuric acid by the contact process, by which process concentrated acid is made direct without subsequent evaporation, as well as by the chamber process, provided in the latter case the price allows it to compete with pyrites. Other products derivable from sulphur, besides sulphuric acid, are sulphur dioxide, (used in every sugar house in Louisiana) carbon disulfide, thiosulphates, etc.

In these four resources enumerated above (petroleum, gas, salt, sulphur) lie a potentiality possessed by few other States, since the two former constitute cheap fuel and a source for raw products for the dyestuff and explosive industry, while in the latter two lie the heavy chemical, or acid and alkali, industries, which are the necessary adjunct to the intermediates for either the color or explosive industry.

Other mineral resources may be mentioned, such as gypsum, lignite, sand, gravel, limestone, and clays. These, however, have not received sufficient developments, except sand, gravel

and clay, to place them in the list given above, when stating the valuation of the resources, although the deposits are sufficiently large to invite investigation and development. The value of Louisiana clay products, which were mainly in brick and tile, for the year 1913, amounted to \$638,491. Gypsum, which is used for cement plasters, hard wall finishes, in plate glass manufacture, and as land plaster for agricultural purposes, has received no development in this State, though from the well drillings of St. Charles, Calcasieu and St. Landry parishes deep beds have been encountered, as well as at Rayburn's Salt Works in Bienville Parish.

Limestone has been developed in Winn Parish for some years, being used for ballast, etc. It is estimated by one company owning property there that they have a deposit five-eighths of a mile wide, one-half mile long, and 150 feet deep, which is suitable for lime making purposes, which means that it would be suitable for the manufacture of bleaching powder, should the electrolytic production of chlorine be located in sufficient closeness thereto.

In 1912 Louisiana produced 933,677 tons of sand and gravel, valued at \$417,041, and in 1913 produced 878,943 tons, valued at \$262,840, which latter is hardly representative on account of the depression at that time.

The lignite deposits are enormous in the northern part of the State, though undeveloped. The importance of these deposits lies in the possible products therefrom and in the fuel value (4000 to 6500 B. t. u.).

The forest area of Louisiana is 16,500,000 acres, and in quantity of timber is surpassed only by the Pacific Coast States and Idaho. It is estimated that Louisiana has (1912) 52,500,000,000 board feet of long leaf yellow pine, 15,200,000,000 board feet of short leaf yellow pine, considerable cypress and hard wood.

In production of marketable lumber Louisiana ranks second, which for 1913 was \$67,600,000. This, however, is only a partial representation of what the lumber interests should yield, since in lumbering the waste amounts to two-thirds of that felled. The full realiza-

tion of the potentiality of the lumber interests of Louisiana, or any other State, may be had only when recognition on the part of the lumbermen comes of their enormous wastes, and that they are leaving in the woods, or throwing away at the mills, many times the value they are putting on the market. The profit in lumbering, which at normal conditions is at best about \$3.00 per thousand feet, is meagre, when compared to what might be realized upon the application of the researches that have been carried out by the National Bureau of Chemistry and private investigators. Realization, that from wood we may produce grain alcohol, paper, producer gas, artificial silk, nitrocellulose, cattle food, tannin extracts, rosin, turpentine, pine oils, rosin spirits, rosin oils, pheneloids, wood alcohol, acetone, and pulp, would bring about a revolution in the manner of cutting and handling lumber in the States.

From the researches of the Bureau of Chemistry, a cord of light wood, such as that left in the woods, costing \$2.00 to \$4.00 delivered at the plant, will yield \$48.00 worth of products, distributed between seven products, each of which is a raw material for some other product. Furthermore, one and one-half tons of waste yellow pine will produce a ton of paper pulp, worth from \$50.00 to \$60.00, and even then only about one-half the content of this waste has been realized. The Southern Paper Company, at Moss Point, Miss., is successfully making kraft paper from yellow pine. A cord of yellow pine will yield 10 gallons of grain alcohol, while a bushel of corn will produce $2\frac{1}{2}$ gallons, and it requires $2\frac{1}{4}$ gallons of molasses to produce one gallon of alcohol. The production of alcohol from yellow pine is beyond the experimental state, as it has been and is being produced on the commercial scale at present by the process of Ewen and Tomlinson. It is estimated by Dr. A. D. Little that the stumps left in the ground contain 35% moisture and $6\frac{1}{2}\%$ rosin, that at a cost of 33 cents each for pulling, taking an average weight of 563 pounds to the stump, the cost of pulling would be \$1.16 per ton, which ton subjected to destructive distillation will yield 6 gallons of light oils, 6 gallons of turpentine, 16 gallons of heavy oils, 48 gallons of tar, and 35 bushels of charcoal, while if subjected to the extraction process, will yield 6 gallons of

turpentine, 2½ gallons of pine oil, 280 gallons of rosin, and extracted chips suitable for paper pulp. He further estimates that the annual waste in the United States from the 50,000,000,000 board feet of merchantable lumber cut amounts to 75,000,000,000 board feet, or 112,000,000 tons, and that the annual waste of yellow pine, (which amounts to 30,000,000,000 board feet), is distributed as follows: 40,000 tons of paper, 3,000 tons of rosin, 300,000 gallons of turpentine, 600,000 gallons of grain alcohol, and fuel enough for all these industries.

One firm in the vicinity of the city of New Orleans derives its power from wood producer gas, utilizing waste slabs, blocks, and sawdust from a nearby sawmill.

It is not too much to say that with proper use of our Southern timber supplies, which in the State of Louisiana, at the rate of cutting and wastefulness now in vogue, will be exhausted in thirty years, we could dominate the paper market of the world, produce untold quantities of grain alcohol, and unlimited supplies of cattle food, and make our naval stores industry one of the largest assets.

Another portion of our forest products that yields only partial returns is our naval stores, on account of the fact that economic methods have not been employed in the extraction from wood, by which by-products are either destroyed, unrefined, or let run to waste many times unexamined and unnoticed. The researches of the Bureau of Chemistry showing a production of \$48.00 worth of materials from a cord of waste wood have been referred to above. In 1909 the value of the naval stores production in Louisiana amounted to \$1,173,000, which is represented by rosin and turpentine alone, yet from 1899 to 1909 the increase amounted for rosin to 486% and for turpentine to 472%, indicating the possibilities if all the products had been recovered.

Cotton and cotton seed products form a potential part of Louisiana's manufacturing resources, both for the value of the fiber for spinning, and for the value of the cotton seed products, such as cotton seed cake, cotton seed oil, hulls, etc.

The cotton fiber is the purest natural form of cellulose, has (as every one is aware) been the chief source of nitrocellulose for explosives, and may continue to be so, if procurable as cheaply

as wood cellulose, or as readily as may become necessary in emergency cases. Nitrocellulose occupies a position in the manufacturing industry of being the raw material for many products besides explosives, among which may be mentioned artificial silk, water proof sheets, artificial leather, pegamoid (used in book binding, upholstery, and as button covering), the basic coating for the best grades of patent leather, for collodion (liquid skin), and for celluloid, which last named is used to supply 10,000 or more moving picture theatres in the United States with photographic films, for photographic films in general, for campaign buttons, for transparent curtains for automobiles, as a laquer for brass and highly polished instruments, and as a vehicle for aluminum paints.

The United States spins 5,800,000 bales of cotton annually, of which the South spins 3,000,000, and the South produces 65% of the world's crop of cotton. In 1914 the area given to cotton in Louisiana amounted to 1,360,000 acres, the value of the cotton therefrom amounting to \$15,184,000.

The cotton seed production for 1913 in Louisiana amounted to 197,000 short tons, valued at \$4,070,000. The wealth of products from cotton seed may be realized, when we consider that \$12.00 to \$14.00 are added to the value of the bale from these products. The added value for Louisiana amounts to \$5,000,000. The products from cotton seed are: Cotton seed meal, utilized for animal food and for fertilizer; cotton seed oil, which when refined is used for salad oils (a considerable portion of our imported olive oil being grown in a radius of 500 miles of New Orleans); for hogless lards, hard fats, for soap making, (for which last mentioned the foots or impure products are admirably suited), and for glycerine.

The sugar industry of Louisiana is almost too well known to deserve comment. The production of cane sugar in this State for the year 1915 amounted to 369,600,000 pounds, while for 1914 it amounted to 585,394,880 pounds, and for molasses 24,194,750 gallons. It is enough to say that it is one of our main agricultural and manufacturing assets.

The rice industry, while essentially agricultural, is as essentially a manufacturing industry. In 1909, of the 71 establish-

ments producing clean rice, Louisiana had 37, the value of the product for the seventy one establishments being \$22,300,000, of which Louisiana's valuation was \$12,500,000. A problem which is open to solution at present is the disposal of rice hulls, and another is the extraction of fats from the rice bran, and still leave the bran in an edible condition for the animal.

According to the 13th Census reports, the value of the manufactures of the South is \$4,000,000,000, which at that time exceeded the value of farm products. The value of Louisiana manufactures was \$223,900,000, of which New Orleans produced \$78,800,000 from her 848 establishments. The capital investment in New Orleans at that time was \$56,900,000, and the value added as a result of manufacturing was \$30,000,000.

The raw materials suitable for manufacturing purposes and refinements may be summarized as petroleum, natural gas, sulphur, salt, cotton and cotton seed, rice, sugar, wood and timber, sand and gravel, molasses and sugar, bagasse from the sugar industry (which at present is utilized for fuel but which may be converted into paper), undeveloped gypsum beds, lignite, and limestones.

Coupled with these and materials found in the adjoining and nearby States, such as bauxite, manganese ores, marble, lithographic stone, silica, kaolin, clays, phosphate rock, coal, fullers earth, zinc and others, together with the advent of development of cheap power, manufacturing enterprises may be expected to find development in this State. Specific attention would be called to the fact that the resources of the adjoining States are within haul of New Orleans, and we would further stress this by citing the great manufacturing city of Great Britain,—Manchester—to which practically all raw materials must bear the shipping costs, many of them from long distances.

A great resource of Louisiana, which has not been mentioned, yet is high in potentiality, is the Port of New Orleans. It has been so provided by a State constitutional amendment that automatic development of port facilities may take place as rapidly as necessity calls for, and that the port front will always belong to the public. The already developed port facilities, the 40 miles of belt railroad publicly owned, together with the river

frontage already available on the opposite side to New Orleans, and the development of the industrial canal connecting Lake Pontchartrain and the Mississippi River, should be listed amongst Louisiana's assets.

Already within the confines of New Orleans and vicinity are such representative manufacturies as fertilizers, potash recovery from alcohol lees, alcohol from molasses and grain, breweries sulphuric acid, salt cake, hydrochloride acid, cotton seed products, soap, glycerine, carbonic acid, wood producer gas, brick and hollow tile, to say nothing of the sugar refining, and various other establishments not enumerated, such as sawmills, metal working plants, cotton mills, etc., to make up the total of 848 industrial enterprises.

Possessed of natural wealth in the basic chemicals, salt and sulphur, in the natural fuels, oil, gas and lignite, and in untold wealth in other resources, besides being in easy access of the coal and mineral fields of the nearby States, and possessed of the second port in the United States, by the proper employment of principles of chemistry, engineering, and the applied sciences, Louisiana may become a potential factor in the manufacturing world, and thereby ably prepare herself to contribute her full share toward the declaration of our National Economic Independence.

HURRICANES.

(A lecture delivered before the Louisiana Engineering Society on March 13, 1916.)

By

DR. I. M. CLINE, Director of the Local Weather Bureau.

MR. PRESIDENT, LADIES AND GENTLEMEN—I had expected to illustrate my talk with slides, but the slides were used in Little Rock on the night of the 10th. and have not arrived, so we will talk on hurricanes. This subject will interest you probably more than anything else at this time.

We experienced on the Gulf Coast, during last year, three severe hurricanes. I do not think we have a record in history of the previous occurrence of three hurricanes on this coast in one year. Two of these hurricanes were severe. The one that passed on August 16, in the vicinity of Galveston and Houston, was nearly as severe as the hurricane of September 8, 1900. The hurricane which passed with its center a little west of New Orleans on the 29th of September was perhaps the most intense hurricane that has ever visited the Gulf Coast. At any rate, we have records that show more intense conditions than records that we have in any other hurricane. Having passed through so many hurricanes in one season, it behooves us to think about those hurricanes and study them to see what we can find out in regard to them. The Weather Bureau succeeded in getting the finest set of records in regard to the hurricane of September 29 that we have of any hurricane, and you have a copy of that record in your library here, but there are some things in connection with this hurricane that were not brought out in those papers, things that have been noted since that paper was written.

You all know where hurricanes originate. They develop in the Caribbean Sea, to the southward, or southeastward, of Porto Rico. As a rule, they have their origin on the edge of what we call the doldrums. We do not know all that contributes to their development. We know some things—we know heat and moisture have much to do with it. There are a great many things about them that we do not know and probably never will know until we get stations in the West Indies and get observations in the

upper atmosphere. But we do know that the Weather Bureau has been able to forecast the movement of these hurricanes across the Caribbean Sea and Gulf of Mexico exactly.

The United States Weather Bureau has vessels equipped with aneroid barometers. These ships send twice a day reports of the pressure, the clouds and winds and the tide swell, so that we know pretty nearly as well what is going on on the ocean now as what is going on on the land. If a storm develops during the day—if a ship runs into a hurricane—a report is sent to Washington at once.

In the early part of September we had a weak hurricane south of Cuba, and it didn't show on the land as it passed across Cuba. On the morning of September 3d a ship about two or three hundred miles west of Key West ran into that storm and the barometer went down so fast that she sent several observations and the Weather Bureau issued hurricane warnings for the east Gulf Coast. The Weather Bureau displays the hurricane warnings where the storm is likely to strike. These storms move from the place of their origin towards the northwest, frequently recurring towards the northeast, when they strike the Gulf Coast.

In these hurricanes we have records of the changes in pressure that are interesting. I am going to talk to-night about the changes in pressure in advance of and following these hurricanes, and the wind in relation to this, but there are a few other things that we want to talk about before I take that up.

The destructiveness of these hurricanes is very great, but it is greatest when the action of wind and water are combined, as in the Galveston hurricane of 1900. There was not much, if any, more wind there in 1900 than we had at New Orleans in 1915, but just stop and think of the destruction at Galveston in 1900 as compared with the small loss at New Orleans. The force of the waves with the debris from wreckage is the destructive element in these hurricanes. We can stand a high wind, except when the water element is combined with the wind. We have a record of as high as 86 miles an hour at New Orleans in 1915, and, of course, a great many houses were damaged, but there was no great destruction of buildings. In Galveston, in 1900, on the Gulf side, where the waves came in, houses were demol-

ished and then the waves would pick up that debris and it would act as a battering ram in the hands of the winds and waves and nothing could withstand it. An area seventeen blocks wide was swept away. But without the water and debris, there would have been nothing like that destruction. On the side of the town where the debris did not reach, the damage was no greater to buildings than it was in New Orleans in the hurricane of 1915.

Of course, "Safety First" seems to be one of the great features of our times, and I suggest that we have laws requiring the construction of buildings that will withstand these hurricanes. We can reduce the loss of life very materially if we will eliminate buildings that are likely to be destroyed by the wind and waves combined. That is demonstrated at Burrwood, by the buildings put up there by the United States Government and the United Fruit Company. Not a single one of those buildings was washed away, and yet we had the highest wind there of record on this coast,—we had a sustained velocity for 19 minutes at the rate of 116 miles an hour; we had a wind velocity of 108 miles for an hour and 106 miles for another hour; we had a velocity for five minutes at the rate of 124, and we had one minute at the rate of 140 miles an hour. We have never had a wind recorded along this coast that would come up to that, yet we have had much greater destruction, with less wind. That suggests to us that we ought to do something towards the protection of the people by forcing them to provide protection for themselves.

We will now take up the difference in the gradients in the front and rear of these hurricanes, and the wind velocity.

We have generally assumed that in the rear of cyclones we have lighter winds and more shallow gradients, but I find in some of these hurricanes we do not get wind in proportion to the gradients in the rear segment of a hurricane. The wind falls below the gradient wind.

In some of these storms, I find that the barometer falls with the approach of the hurricane at about the same rate that it rises after it passes; and in others, I find that the gradient is steeper after the storm passes than it was as the storm approached.

In the September, 1900, hurricane at Galveston, the center of the hurricane was probably about 15 miles west of Galveston. Unfortunately, I have not a slide showing the fall and rise of the barometer at that place, but it was slow, relatively, but the change was sharp. When a place is near the center of the storm, you will get a rapid fall and a rapid rise in the barometer. When you are outside, 30 miles away, you get more of a curve. You can tell when you are near the center of the hurricane, for the curve is always relatively short.

In the 1900 hurricane at Galveston the barometer fell .77 inch during the six hours preceding the passage of the center. During the six hours following the passage of the center, it rose .61 inch, showing that the gradient was not quite so steep in the rear of the hurricane at Galveston as it was in the front of the hurricane. The greatest fall in the barometer occurred just two hours prior to or in the third hour preceding the passage of the hurricane, and was .19 inch in one hour, then in the next hour it was .17 inch, and in the hour preceding the passage of the center, it was .14 inch. As the hurricane passed, in the first hour after the passing of the center, the barometer rose .13; in the second hour, .17 inch, and in the third hour, .15. Then, the rate of rise gradually decreased.

When we take up the hurricane of August 16 and 17 in 1915, we find at Galveston quite a different condition in the rise and fall of the pressure to that which took place in 1900. During the six hours preceding the passage of the center, the barometer at Galveston, during the August, 1915, hurricane, fell .41 inch, and the greatest fall of the barometer occurred in the sixth and fifth hours preceding the passage of the center, and during the two hours preceding the passage of the center, the fall was only .07 inch. When the hurricane passed, conditions were somewhat reversed and there was a rapid rise. The gradient was very much steeper in the rear than it was in the front segment. Against a fall of .41 in six hours preceding the passage of the center, we got a rise of .65 in the six hours following the passage of the hurricane. In the first hour following the passage of the center, we had a rise of .15; in the second hour, .12; third hour, .10; fourth hour, .13; fifth hour, .10; sixth hour, .05.

At Houston we find an entirely different change in the pressure gradient to what we found at Galveston in the same hurricane. We find, in the six hours preceding the passage of the center, a fall of .99 inch at Houston. In the hour preceding the passage of the hurricane, there was .30 inch fall. In the second hour preceding, .13; and in the three next hours, .12. Now, after the center of the hurricane had passed, the rise was slightly greater, but not much. We get, in the six hours following the passage of the center, a rise of 1.01 inches, or just .02 inch greater than the fall in six hours preceding the passage of the center, but in the first hour after the passage of the center, we get .33; in the second, .18; in the third hour, .15; then, two hours of .10 each; then .08, and then .07. We have an increase in the first hour following the passage of the center of .03 inch over the decrease in the hour just preceding the passage of the center.

We come now to the gradient in the September 29 hurricane at New Orleans. It was the study of that hurricane that caused me to work up this data for the other hurricanes. The gradient at New Orleans averaged .02 inch an hour for the 6 hours following the passage of the center steeper than it did in the six hours preceding the passage of the center. Here in New Orleans, the fall during the six hours preceding the passage of the center was 1.04 inches, and the rise was 1.21 inches, in the six hours following the passage of the center. During the hour preceding the passage of the center, we had a fall of .25 inch; then, the hourly fall was .37 inch; .17, .12, .05 and .08, in the sixth hour preceding the passage of the center, we had a rise in the first hour of .27; in the second hour, .35; in the third hour, .22. The greatest difference was in the third hour following the passage of the center of the storm.

We get some interesting matter in connection with the wind velocity and the barometer gradients at New Orleans, September 29, 1915. The wind increased during the six hours preceding the passage of the center of the hurricane as follows, commencing at 12:00 noon (the center of the hurricane passed about 6:00 p. m.): From 12:00 to 1:00, 48 miles (that is the total movement in the hour); from 1:00 to 2:00 p. m., 49 miles; from 2:00 to 3:00 p. m., 50 miles; from 3:00 to 4:00 p. m., 50 miles; from

4:00 to 5:00 p. m., 60 miles, and from 5:00 to 6:00, 62 miles; from 6:00 to 7:00, 41 miles, a falling off of 21 miles here. About 24 miles is what the decrease should have been, and taken all in all, the decrease averages, I believe, about 28 miles. Then, the difference in the gradients in the front and rear should have made a difference of about 5 or 6 miles more, so there is a loss of about 10 miles in the gradient wind, that we cannot account for by the difference in the movement of the hurricane, which was 12 miles per hour. From 7:00 to 8:00 p. m., the velocity was 33 miles; from 8:00 to 9:00, 27, and then, in each succeeding hour, 22, 26, and then 30. In the maximum velocity, we get a much greater difference. In the hour ending at 1:00 p. m., we had 54 miles; 2:00 p. m., 54 miles; 3:00 p. m., 56 miles; 4:00 p. m., 54 miles, and 5:00 p. m., 72 miles, and at 6:00 p. m., 86 miles; 7:00 p. m., 63 miles; 8:00 p. m., 46 miles; 9:00 p. m., 30 miles, and none above 30 after that hour. The wind at 1:00 p. m. was northeast; 2:00 p. m., east; 3:00 p. m., east; 4:00 p. m., east; 5:00 p. m., southeast; 6:00 p. m., southeast; 8:00 p. m., southeast, and then southwest the remainder of the night.

The rainfall was heaviest when the wind shifted from northeast to east, decreased while the wind was from the east, and was heavier again when it shifted from east to southeast. The rain was .84 inch during the hour ending at 1:00 p. m.; it was .91 during the hour ending at 2:00 p. m.; .30 during the hour ending at 3:00 p. m.; .58 during the hour ending at 4:00 p. m.; 1.05 inches during the hour ending at 5:00 p. m.; .60 during the hour ending at 6:00 p. m.; a trace at 7:00 p. m.; .01 inch at 8:00 p. m.; .07 at 9:00 p. m., and trace during the remainder of the night.

East of the center of the hurricane, the rainfall was relatively heavy generally to the Atlantic Coast. The rainfall was negligible 50 miles west of the center. Just along the center, that is, within 8 miles either side of the center, the rainfall ranged from 8 to more than 14 inches during the passage of the hurricane.

Take the records at Burrwood. We have incomplete records there, but they are good. At Burrwood, we had a reversal in the pressure conditions we had at New Orleans. During the six hours preceding the passage of the center, we had a fall of .38

inch, and during the six hours following, a rise of .17 inch. Now, it is probable that the changes in the rise and fall of the barometer in the same hurricane with the passage of the hurricane at different places, like we had at Galveston and Houston, and at Burrwood and New Orleans, may be due to the recurve of the hurricane. Of course, that is something we will have to look into—something we will have to study out—and I guess we will require more observations than we have now, to determine just what it is that causes the variation in the gradient in the front and rear of the same storm.

I believe this is about all I want to say to-night. There are a few other things that I wanted to talk about, but since my slides did not come, I will close.

GROUTING PROCESS USED IN CLOSING CRACKS IN REINFORCED CONCRETE CANAL AT NAPOLEON AVENUE AND COLISEUM STREET.

By

ALF. F. THEARD.

Some three years ago, as part of a large contract of the Sewerage and Water Board, a 10-foot wide reinforced concrete canal was constructed on Napoleon avenue, between Constance and Pitt streets. It is located under the paved portion of the roadway, almost immediately adjoining the curb on the lower side of the neutral ground.

It has been the policy of the Drainage Department of the Sewerage and Water Board to construct only large canals, over fifteen feet wide, on pile foundations and, with few exceptions, all smaller canals are supported on spread foundations, with 4" pecky cypress decking on the sub-grade. In this case, as the work advanced from Pitt street, we found the bottom very unsatisfactory showing quicksand with a large amount of water. It got worse as we neared Coliseum street and, although the canal was only ten feet wide, it was decided to use piling 5'4" centers, with caps running parallel to the canal to support the decking. Due to a short delay in obtaining piling, the change in the foundation was made only after reaching the river side of Coliseum street intersection. Work was finished and the street was paved over eighteen (18) months ago.

About the middle of January, of the present year, our attention was called to a depression in the pavement of Napoleon avenue, near the lower lake corner of Coliseum street. This depression was over one of our drainage pipe lines between the canal and the manhole. An examination of this was made; it was found partly crushed and a few of the lengths broken. The pipe was repaired, the trench backfilled and the pavement replaced. On February 4, another cave developed on the neutral ground side of the canal, at the lake side of Coliseum street, and, within a few days, got so serious that it became evident that it was caused by something more than a broken pipe joint. As a matter of fact, the whole pipe line (60 feet long) had crushed.

A thorough inspection was made and disclosed bad cracks in the Napoleon Avenue Canal. Levels taken in the canal showed a subsidence extending a distance of about 150 feet with its maximum depth of 12 inches at the main crack, say 50 feet from the point at which the piling foundation began, the entire depression being over that last portion of the canal which was constructed on decking foundation. A considerable amount of quicksand was found in the canal on the down grade side of the cracks and further examination proved that the entire structure—canals and connections—was undermined.

Orders were immediately issued to have a brick dam built on the upper grade of the trouble point and proper flumes were placed about four (4) feet above the invert to carry the daily flow to a sack dam about fifty (50) feet down grade, thus allowing the drainage of the district to be taken care of uninterruptedly during both dry and storm periods. Sump holes were dug on each side, outside of the canal, and continuous pumping started in an endeavor to keep the bottom of the canal dry between the two dams so that it could be repaired, the intention being to close the cracks and to build a new bottom with reinforced concrete of a thickness sufficient to restore the invert to its original grade.

One of the difficulties to be met was that the water in the Mississippi River was very nearly at its highest level just at this time, or some 24 feet higher than the invert of the canal at Coliseum street and Napoleon avenue, increasing the underground flow. It was necessary to pump continuously, day and night, to keep the bottom dry and before any satisfactory result could be obtained in working upon the cracks. The amount of quicksand which was being carried through the pumps, it was found, was undermining the territory contiguous to the canal, an area approximately 100 feet long by 75 feet wide. In the meantime, cracks were opening on the side and in the top of the canal near the original cracks and there was a slight, but continued, settlement of the canal. It was decided to attempt caulking the smaller cracks with oakum and lead wool and in the large crack across the bottom quick setting cement was placed from the top and weighted down with heavy sacks until set. These, however,

were only temporary expedients to stop any large flow of quicksand into the canal from the outside and avoid further pumping and consequent removal of quicksand from the outside of the canal through the pumps. Sounding showed the undermining to be more than expected and that there was a pocket of live quicksand under the canal, the decking having left its original position and gone down some eighteen (18) inches below the grade at the main crack.

It was then decided to try the grouting process which had proven satisfactory in closing leaks at the Water Purification Plant. An ordinary hand force pump was obtained and properly connected to a box from which it was fed with grout, the mixture of which varied between $1\frac{1}{2}$ and 1 of cement to 1 of sand. Starting near the river end of the damaged section a series of holes were drilled through the concrete bottom at intervals of about four (4) feet. 1" pipes were placed therein and the grout pumped through rubber hose into them until no more could be forced in. The pipes were then removed and the holes sealed, in fact, after pumping grout through each hole to refusal, upon the removal of the grout pipe the holes were found practically to have sealed themselves. All pumping of water from the sump holes had been stopped simultaneously with the operating of the grouting pump and the sump holes, themselves, were partly backfilled so as to confine the grout and force it to penetrate into any existing cracks in the masonry and into voids around the masonry as well as into the surrounding quicksand.

After the bottom had been entirely treated holes were drilled through the side walls, just above the bottom of the canal near the main cracks and grout was pumped in as above which found its way upward in the side cracks and even along the top of the canal until all leakage was stopped, showing positively that the grout following the flow had entered the cracks from below or from the outside and had closed them completely.

A new reinforced concrete bottom will be constructed over that portion of the canal which has shown cracks, thereby restoring the bottom to its proper grade and strengthening it by the increased thickness of reinforced concrete.

Levels taken from time to time since prove that the subsidence has stopped entirely since the grouting was completed and we now consider the cause of trouble has been removed.

The length of canal in which any settlement occurred was about 150 feet, the settlement being about 12" at the most and decreasing to nothing at either end. This is the first trouble of this character which has occurred in about twenty-five (25) miles of similar masonry lined canals. Treated by any other means than the grouting process its cure would have been much more expensive with greater liability of recurrence, since the injection of the grout not only sealed the existing cracks but also modified the surrounding soil in their locality so that its tendency to be carried through small openings into the canal is overcome.

FLOOD CONDITIONS AT NEW ORLEANS AS AFFECTED BY THE DIVORCEMENT OF THE ATCHAFALAYA AND MISSISSIPPI RIVERS.

By
J. P. KEMPER.

The object of this paper is to discuss the effect upon flood stages, at New Orleans, that would result from the divorcement of the Atchafalaya River from the Mississippi, which plan I believe to be only waiting the availability of funds for its accomplishment, by those in present control of the flood situation.

The likelihood of a large sum of Government money soon becoming available makes this discussion extremely opportune.

Let me state, again, (I always emphasize this fact) that the discussion, in so far as I am concerned, is entirely impersonal, in the interest of the public good, as I see it, and not against the interest of any individual. I have no ax to grind, and want no job, but I am anxious to force a discussion, on its technical merits, of a question which proponents of "levees only," now in control of all matters pertaining to floods on the Mississippi River and its tributaries, most pointedly avoid discussing.

Hydrostatics is an exact science, when all the operating forces can be isolated and reckoned with.

For the treatment of flow of water in open channels, if the cross section were uniform, the slope uniform and the channel straight, the results could be computed with the greatest accuracy.

In a river, such as the Mississippi, the cross section and slope are variable and the channel is anything but straight.

Owing to the curve in the river, centrifugal and centripetal forces are involved, and, due to the mobility of the particles of the water these forces produce eddies, and, thereby modify the flow.

This characteristic of the river serves as a most efficient haven of refuge to the proponents of "levees only." When an attempt is made to hold one of them down to hydrostatic laws, as pertains to the river, he falls back on the hackneyed idea that the

"Old Mississipp" has wondrous and peculiar ways of her own, and, like Necessity, "knows no law." In his next breath he will tell you that only levees can accomplish the desired result of perfecting flood control.

I can not believe that the Mississippi River possesses any peculiarities which exempt it from the laws of nature. If we understand the laws properly, it will be evident that she is just as docile as the solar system.

I cannot help believing that the velocity of flow varies as the square root of the slope, because that fact is necessary to conform to the law of gravitation. Likewise, I believe that the volume of flow varies as the cross section because that is necessary to fulfill the simplest laws of proportion. I believe that, if proper allowance can be made for resistances due to increased specific gravity, friction, wind, tide (near the mouth), centrifugal and centripetal forces, there would be no difficulty in determining the output of the river, at every stage of the water.

It is true that this little "if" embodies a formidable list of difficulties. I believe, however, they can be practically overcome by the following combination of experience and reasoning.

The formula universally employed for the flow of water in open channels is Kutter's formula, being practically identical with Chezy's formula, used in Humphrey's and Abbott's "Physics and Hydraulics of the Mississippi River."

This formula is usually expressed as " $v = C \sqrt{R S}$ " in which " v " is the velocity of flow, " C " is a constant whose value varies with the size and depth of the streams, it being greater for large, deep, streams than for small shallow ones. " R " is the hydraulic radius obtained by dividing the cross section by the wet perimeter, " S " is the surface slope of the stream.

I shall apply this formula to the flow of water down the Mississippi, past New Orleans, during the flood of 1912. Since the official Government gauge is at Carrollton, and discharge observations were taken there, during this flood, I shall refer my calculations to the Carrollton gauge.

From the report of the Mississippi River Commission for 1912, I learn that, on May 7, there flowed past New Orleans

1,343,046 cubic feet of water per second. That, at the point of observation, the river was 2446 feet wide, that the cross section was 193,251 square feet, and that the gauge registered 20.4 feet at the time of observation. I also learned that the average velocity of flow was 6.94 feet per second. This, of course, was obtained by dividing the volume of flow by the cross section.

Although the river got a little higher, this was the highest point at which discharge observations were taken.

Suppose we apply the above known quantities to Kutter's formula, and solve the formula for the value of the constant "C."

Let us ascertain the slope in the following manner: It is about 113 miles from Carrollton to the mouth of the river, where mean Gulf level is attained. The "O" of the Carrollton gauge is 0.131 below mean Gulf, therefore a gauge reading of 20.4 means an actual height above mean Gulf of 20.269. By dividing 20.269 by 113×5280 , and reducing to lowest terms, we will find that the slope from Carrollton to the Gulf is $1 \div 29436$. By reference to a cross section plat of the river, I find that for a width of 2446 feet the wet perimeter will be 2500 feet.

Now, if we will substitute these known quantities in Kutter's formula, and solve for "C," we will find its value to be 135.43.

Suppose, now, we try to check these results by some other observations.

Further examination of the reports of the Mississippi River Commission develops that, in 1883, the maximum discharge at Carrollton was at a gauge reading of 15.4, and was 1,086,000 cubic feet per sec. Likewise, in 1898, the maximum gauge reading was 15.6, and the discharge 1,096,000 cubic feet per sec. Again, in 1904, the maximum gauge reading was 15.8 and the discharge 1,097,935.

I consider these results as strikingly near each other, and I have averaged the three, and concluded that a gauge reading at Carrollton of 15.6 corresponds to a discharge of 1,093,312 cubic feet per sec.

The above reports did not give the cross section, width and velocity, as was given in the case of 1912, but they are easily deduced, by subtracting from the cross section the difference due

to a stage of 15.6 instead of 20.4, and, in like manner, the width and wet perimeter are obtained. I find the cross section to be 181,579 square feet, the width 2417 feet and the wet perimeter 2470.

By dividing the volume of flow by the cross section, I get the average velocity of flow to be 6.02 feet per second.

By solving Kutter's formula for "C," I find it to be 137.9, slightly greater than at the highest stage, but strikingly close. This difference may be due to the greater resistance of that portion of overland flow, at the higher stage, or it may be due to local causes, or inaccuracies necessary to observations. At most, it is insignificant.

This is an excellent opportunity to compare the velocities obtained from observations with those calculated by the law which says they vary as the square root of the slope.

Let us assume the velocity of 6.94, at a stage of 20.4 at Carrollton to be absolutely correct.

By the same method as that employed at the stage of 20.4, I determine that the surface slope, at 15.6 $1 \div 38570$. Now, if we will assume as correct that the velocity at 20.4 is 6.94 feet per second and solve the proportion that the velocities vary as the square roots of the slopes, for the stage of 15.6, we will find that velocity to be 6.05, .03 greater than the velocity obtained by dividing the volume of flow by the area of cross section, for the same stage.

These results are so close as to cause us to resent the imputation that the "Old Mississippi" will not come under the law.

On April 12, 1912, when the gauge at Red River Landing registered 48 feet there was passing through Old River, from the Mississippi to the Atchafalaya, 347,229 cubic feet of water, per second. Owing to return crevasse water, through the Tensas basin, this amount gradually diminished, until April 29, when it ceased, altogether, and began to flow the other way, that is, into the Mississippi. Two days later, May 1, Torras levee broke, and relieved the pressure. This crevasse increased in size, until, on May 14, it discharged 259,318 cubic feet per second.

Had levees held intact, there would have been no return crevasse water, and Old River would have continued to relieve the

1,343,046 cubic feet of water per second. That, at the point of observation, the river was 2446 feet wide, that the cross section was 193,251 square feet, and that the gauge registered 20.4 feet at the time of observation. I also learned that the average velocity of flow was 6.94 feet per second. This, of course, was obtained by dividing the volume of flow by the cross section.

Although the river got a little higher, this was the highest point at which discharge observations were taken.

Suppose we apply the above known quantities to Kutter's formula, and solve the formula for the value of the constant "C."

Let us ascertain the slope in the following manner: It is about 113 miles from Carrollton to the mouth of the river, where mean Gulf level is attained. The "O" of the Carrollton gauge is 0.131 below mean Gulf, therefore a gauge reading of 20.4 means an actual height above mean Gulf of 20.269. By dividing 20.269 by 113×5280 , and reducing to lowest terms, we will find that the slope from Carrollton to the Gulf is $1 \div 29436$. By reference to a cross section plat of the river, I find that for a width of 2446 feet the wet perimeter will be 2500 feet.

Now, if we will substitute these known quantities in Kutter's formula, and solve for "C," we will find its value to be 135.43.

Suppose, now, we try to check these results by some other observations.

Further examination of the reports of the Mississippi River Commission develops that, in 1883, the maximum discharge at Carrollton was at a gauge reading of 15.4, and was 1,086,000 cubic feet per sec. Likewise, in 1898, the maximum gauge reading was 15.6, and the discharge 1,096,000 cubic feet per sec. Again, in 1904, the maximum gauge reading was 15.8 and the discharge 1,097,935.

I consider these results as strikingly near each other, and I have averaged the three, and concluded that a gauge reading at Carrollton of 15.6 corresponds to a discharge of 1,093,312 cubic feet per sec.

The above reports did not give the cross section, width and velocity, as was given in the case of 1912, but they are easily deduced, by subtracting from the cross section the difference due

to a stage of 15.6 instead of 20.4, and, in like manner, the width and wet perimeter are obtained. I find the cross section to be 181,579 square feet, the width 2417 feet and the wet perimeter 2470.

By dividing the volume of flow by the cross section, I get the average velocity of flow to be 6.02 feet per second.

By solving Kutter's formula for "C," I find it to be 137.9, slightly greater than at the highest stage, but strikingly close. This difference may be due to the greater resistance of that portion of overland flow, at the higher stage, or it may be due to local causes, or inaccuracies necessary to observations. At most, it is insignificant.

This is an excellent opportunity to compare the velocities obtained from observations with those calculated by the law which says they vary as the square root of the slope.

Let us assume the velocity of 6.94, at a stage of 20.4 at Carrollton to be absolutely correct.

By the same method as that employed at the stage of 20.4, I determine that the surface slope, at 15.6 $1 \div 38570$. Now, if we will assume as correct that the velocity at 20.4 is 6.94 feet per second and solve the proportion that the velocities vary as the square roots of the slopes, for the stage of 15.6, we will find that velocity to be 6.05, .03 greater than the velocity obtained by dividing the volume of flow by the area of cross section, for the same stage.

These results are so close as to cause us to resent the imputation that the "Old Mississippi" will not come under the law.

On April 12, 1912, when the gauge at Red River Landing registered 48 feet there was passing through Old River, from the Mississippi to the Atchafalaya, 347,229 cubic feet of water, per second. Owing to return crevasse water, through the Tensas basin, this amount gradually diminished, until April 29, when it ceased, altogether, and began to flow the other way, that is, into the Mississippi. Two days later, May 1, Terras levee broke, and relieved the pressure. This crevasse increased in size, until, on May 14, it discharged 259,318 cubic feet per second.

Had levees held intact, there would have been no return crevasse water, and Old River would have continued to relieve the

Mississippi in an amount whose value would depend, in a large measure, on the amount of Red River water the Atchafalaya had to carry, but it is reasonable to suppose that the amount would not be less than 347,229 cubic feet and it would probably be considerably greater.

The problem I wish solved is this: If a stage of 15.6 at Carrollton corresponds to a discharge of 1,097,935 cubic feet per second and a stage of 20.4 corresponds to a discharge of 1,343,046, what stage will be reached when the river is called upon to take care of 1,343,046 plus 347,229 cubic feet per second, due to the divorcement of the Atchafalaya?

There is a formula in Calculus from which this problem can be solved, but it has been 30 years since I studied Calculus, so I will leave the accurate method to some of our college professor members, and I will adopt the approximate method of trial.

Suppose we try a stage of 27.40, at Carrollton, 7 feet higher than the stage at which observations were taken in 1912, and 6.35 higher than has ever been.

I find the slope will be $1 \div 21879.7$; the cross section 210,520 square feet, the width 2488 feet; the net wet perimeter 2542.5 feet.

By applying the law that the velocity varies as the square root of the slope, I find the average velocity to be 8.05 feet per second. By multiplying this by the cross section we get a volume of 1,694,686 cubic feet per second. Since the amount we wanted to take care of was 1,685,275, we will have just sufficient margin to be sure it is enough.

Raising the flood stage at New Orleans, by 6.35 feet would be rather a serious proposition. Is there an engineer connected with levee work who will go on record advocating such a policy? If not, it behooves him to go on record and disprove, if possible, the deductions I have stated herein.

It would be necessary to raise levees above New Orleans more than at New Orleans, because, at New Orleans, both slope and cross section will have been increased, and it will require that the levees above New Orleans be raised an amount equal to that at New Orleans before there is any increase in slope, and consequently in velocity.

In an issue of *The Times-Picayune* of March 23, 1916, Major W. G. Caples is quoted as saying that the levees are adequate for all purposes, only needing to be brought up to a standard three feet above what would be required to carry 2,000,000 cubic feet of water per second. Being the United States engineer, in charge of levee work in this district, what Major Caples says must needs carry weight. If he was correctly quoted, he said a great truth, and at the same time laid out a big job.

I do not think there is any doubt that 2,000,000 cubic feet per second would solve the problem; I simply ask how high the levees must be to accomplish this purpose.

Proceeding along the same lines as employed by me in my calculations above, I find that the levees, at New Orleans, must withstand a stage of 33 feet to carry 2,000,000 cubic feet per second. This is 12 feet higher than the highest water known.

And up the river it will be worse and worse.

Will some one with the authority of experience please tell us how it is to be done within the limits of reason.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Board of Direction, March 13, 1916

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

Minutes of the last meeting were read and approved.

Applications from Messrs. John H. O'Neill and David L. Cullom for Resident Membership, approved by the Membership Committee, were ordered to ballot. Application from Frank R. Shaw for transfer from Student to Junior Member, approved by the Membership Committee, was ordered to ballot. Application from Thomas White for transfer from Junior to Resident Member was ordered to ballot, subject to endorsements and the approval of the Membership Committee.

A communication from Mr. G. W. Lawes was read. Mr. Lawes stated that Mr. M. P. Robertson desired to be reinstated as a member of the Society and enclosed check for \$1.50 to cover his back dues. It was moved and carried that Mr. M. P. Robertson be reinstated a member of the Society.

A communication from Mr. S. L. Menge was read. Mr. Menge stated that he had informed Mr. Datz that he desired to resign at the end of the year 1915. It was moved and carried that Mr. Menge's resignation be accepted.

A communication from the John Crerar Library, Chicago, was read. The Library desires to exchange publications with us. It was moved and carried that we exchange publications and furnish the Library with a complete file of our Proceedings if possible.

The matter of changing certain members classed on the books as Non-resident to Resident was taken up. Communications from Messrs. Wm. E. Atkinson and Edward W. Bres were read; they stated that they did not consider themselves residents of the Parish of Orleans. It was moved and carried that Messrs. Wm. E. Atkinson and Edward W. Bres be considered Non-resident Members of the Society.

The Secretary stated that the inventory of the books and magazines of the Society and the furniture and improvements to the library would exceed \$2000. It was moved and carried that the Treasurer and Secretary take up the matter of obtaining a policy of \$2000 on the property and improvements of the Society and report back to the Board of Direction.

The following bills were approved for payment:

The Q. & C. Co., New York (Refund on Adv. bill paid twice).....	\$ 28.00
A. Daubert (Refreshments, February meeting).....	10.50
Power (Subscription)	2.00
Railway Age Gazette (Subscription).....	5.00
Miss E. Francke (Stenographic services).....	7.00
Tulane University Press (February Proceedings).....	179.20
Tulane University Press (Printing sundry items).....	23.75
W. T. Hogg, Secretary (Salary and incidentals).....	24.91

Financial statements of the General Fund, Proceedings Fund and Cash Fund were submitted by the Secretary and accepted. The statements showed a balance in the General Fund for February \$79.66 and a standing balance to date \$391.17; balance in the Proc. Fund from February issue \$177.74, and a standing balance to date \$289.94; and cash on hand after all bills \$848.00.

The matter of dropping delinquents who had not paid the balance of their dues for 1915 was taken up. It was moved and carried that action be postponed until the next meeting.

Mr. Young stated that the Southern Pine Association had made a very careful selection of flooring for the Library and had donated it to the Society. It was moved and carried that the Association be extended a vote of thanks.

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Society, March 13, 1916.

The meeting was called to order with President Young in the chair and 60 members and guests present.

Minutes of the previous meeting were read and approved.

Mr. Young stated that the Southern Pine Association had made a careful selection of flooring for our Library and had donated it to the Society. Mr. Young stated that the Board had passed a resolution thanking the Southern Pine Association; the action of the Board was unanimously approved. Mr. Young also stated that a vote of thanks was due Mr. Riess, who had supervised the work in the Library without compensation; this was also unanimously approved.

Mr. Shaw, chairman of the Library Committee, stated that the Committee had not had sufficient time to arrange the books in the cases in the desired order, but would do so shortly. It was the intention of the Committee to keep up the card index, but the books would be arranged according to subjects and placed on separate shelves, which would be labeled.

Professor Gregory, chairman of the Technical Papers Committee, stated that the paper for the next meeting would be on the Resources of Louisiana by Prof. Williamson of the Department of Chemistry, Tulane University, who had given that subject considerable study, and would, no doubt, present a very interesting paper. Prof. Gregory also stated that the program for the entertainment of the Am. Soc. of Mechanical Engineers had been completed, and rendered a synopsis of the program.

The technical exercises of the evening were then held. Dr. I. M. Cline of the local Weather Bureau gave a very interesting talk on "Storms." Dr. Cline's talk was followed by considerable discussion, during which he answered a shower of questions. It was moved and carried that Dr. Cline be extended a rising vote of thanks.

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

W. T. HOGG, Secretary.

Special Meeting of the Society, April 6, 1916.

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

Mr. Young stated that the object of calling the meeting was to hear a talk on Engineering Co-operation by Mr. C. E. Drayer, Secretary of the Cleveland Engineering Society.

Mr. Drayer then gave his talk, which was accompanied by slides showing the work of the Cleveland Engineering Society in advertising the work of the Engineer. The talk was followed by a brief discussion, which was shortened because Mr. Drayer had to leave on a night train.

There being no further business, the meeting was adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Board of Direction, April 10, 1916.

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

Minutes of the last meeting were read and approved.

Ballots for the admission of new members were opened. There were 40 formal and 5 informal ballots. The following were elected:

Resident Members—David L. Cullom, 3629 Baronne street, New Orleans.

John H. O'Neill, 936 Arabella street, New Orleans.

Adam J. Haaser, 715 Oliver street, New Orleans.

Transfer from Junior to Resident Member—Thomas White, Southport-New Orleans.

Associate Member—J. M. Vanderveer, New Orleans.

Non-Resident Junior Member—Frank Roger Duvie, care U. S. S. Lake Brogne, Natchez, Miss.

Transfer from Student to Resident Junior Member—John A. Brookshire, Jr., 1217 St. Roch Ave., New Orleans.

Frank Russell Shaw, 4481 De Montluzin street, New Orleans.

The action of the President in ordering the applications of Messrs. Adam J. Haaser, Frank R. Duvie, and J. M. Vanderveer to be sent through the ballot after the approval of the Membership Committee was approved.

The application of Mr. Walter B. Moses for reinstatement as a Junior Member was read. It was moved and carried that Mr. Walter B. Moses be reinstated as a Junior Member.

The matter of taking out a new policy of insurance was taken up. It was moved and carried that the matter be placed in the hands of the President. It was moved and carried that the inventory of the property of the Society be spread upon the Minutes of the Society.

Communications from Power and the Engineering Magazine were read. They agreed to exchange with us for our Proceedings.

The resignation of Mr. Chas. H. Brookshire, Student Member, was accepted with regret.

The following bills were approved for payment:

Tulane University Press (Printing, general).....	\$8.65
Tulane University Press (Printing for Proc.).....	6.75
Frank G. Churchill (Architect, New Library).....	25.00
Engineering Record (Sub. 1917, 1918, 1919).....	9.00
W. T. Hogg (Salary and incidentals).....	23.25
Dameron-Pierson Co. (Record book for Lib.).....	1.68
Owen Gernon (Binding magazines).....	15.00
Farish Art Store (Picture frames).....	12.45
F. N. Norman (Collections).....	11.13

The financial statements of the General Fund and Cash Fund were submitted by the Secretary and accepted. The statements showed a balance in the General Fund for March \$101.00, and a standing balance to date \$492.17; and cash on hand after all bills are paid \$907.80.

The Secretary reported that Mr. ———— was still delinquent in his dues for 1915. It was moved and carried that Mr. ———— be dropped from the membership.

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Society, April 10, 1916.

The meeting was called to order with President Young in the chair and 70 members and guests present.

The minutes of the previous meeting were read and approved.

Mr. Shaw, chairman of the Library Committee, stated that he would

like each member to write in suggestions for new books, as he understood that the funds were limited, but would try to secure as many books as possible.

A communication from the Engineering Magazine was read. It compliments our Proceedings, and offers to exchange for same. A communication from Power offering to exchange for our Proceedings was read.

The matters of endorsing the Uniform Boiler Code of the American Society of Mechanical Engineers was taken up. After a brief discussion the following resolution was passed:

BE IT RESOLVED, That the Louisiana Engineering Society endorses the Boiler Code of the American Society of Mechanical Engineers.

The technical exercises of the evening were then held. Professor Charles S. Williamson, Jr., read a very interesting paper entitled: "Industrial Resources of Louisiana." It was moved and carried that Professor Williamson be extended a rising vote of thanks.

There being no further business, the meeting adjourned to the collocation.

W. T. HOGG, Secretary.

Regular Meeting of the Board of Direction, May 4, 1916.

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

Minutes of the last meeting were read and approved.

Applications from Messrs. Jas. D. Beck and Oscar Riess for Resident Membership were ordered to ballot as soon as additional applications are received.

An application from Mr. E. H. Rousseau for reinstatement as a Resident Member was read. It was moved and carried that Mr. Rousseau be reinstated as a member of the Society.

Mr. Young stated that Mr. Baldwin, engineer for the Illinois Central at Chicago, had represented the Society at the Conference on Engineering Co-operation. It was moved and carried that a resolution of thanks be extended to Mr. Baldwin.

The work of the Membership Committee was discussed; Mr. Young suggested that a letter should be sent to engineers who would be desirable as members of the Society. It was moved by Mr. Manley, seconded and carried, that the letter to prospective members be approved, and that the expense necessary in getting out the letters be paid by the Society.

The following bills were approved for payment:

John Riess (Labor and material in refitting Library).....	\$866.62
Tulane University Press (Printing and postage).....	70.90
Tulane University Press (Printing and mailing April Proc.).....	197.20
Douglas Anderson (Salary as Editor Proc., Jan-June).....	150.00
H. J. Harvey (Photo. of Library interior for Proc.).....	3.50
Fabacher's Rathskeller (Refreshments, April meeting).....	7.00
L. C. Datz (Pictures for Library).....	2.75
W. T. Hogg, Secretary (Salary and incidentals).....	28.97

The financial statement of the General, Proceedings, and Cash Funds were submitted by the Secretary and accepted. The statements showed a deficit in the General Fund for April \$44.81, and a standing balance to date \$451.13; a balance in the Proceedings Fund from the April issue \$18.41, and a standing balance to date \$208.35; and cash on hand after all bills are paid \$162.52.

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Society, May 8, 1916.

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

The minutes of the previous meeting were read and approved.

The matter of endorsing the Uniform Boiler Code of the American Society of Mechanical Engineers was taken up for a second endorsement. The following resolution was passed:

BE IT RESOLVED, That the Louisiana Engineering Society endorses the Boiler Code of the American Society of Mechanical Engineers.

Mr. Henry J. Malochee addressed the Society on the question of the proposed improvements on the Upper Protection Levee. Mr. Malochee stated that the available funds should be spent on the front and rear levees of the city, and that engineers as public citizens should oppose the proposed expenditure.

The technical exercises of the evening were then held. Mr. J. E. Rhodes, Secretary of the Southern Pine Association, read a paper entitled, "The Density Rule for the Grading of Select Structural Yellow Pine Timbers." The paper was illustrated by moving pictures.

Mr. F. P. Hamilton read a paper entitled, "Creosoted Wood Block Pavements," which was also illustrated by moving pictures. The papers were followed by a discussion, after which Messrs. Rhodes and Hamilton were voted a rising vote of thanks.

There being no further business, the meeting adjourned to the colation.

W. T. HOGG, Secretary.

ADDITIONS TO LIBRARY.

Applied Mechanics.

Vol. I. Statics and Kinetics—Fuller & Johnston.

Library Receives—

Quarterly Journal, Montana Society of Engineers.

Monthly Journal of Utah Society of Engineers.

Journal of the Engineers' Club of St. Louis.

Journal of the Am. Soc. Engineering Contractors.

Quarterly Journal of American Waterworks Association.

The Proceedings of the Louisiana Engineering Society

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

DOUGLAS ANDERSON, Editor.

The Louisiana Engineering Society is not responsible for any
statement made or opinion expressed in this publication.

Subscription, \$2.00 per annum

Single copy, 35 cents

ADVERTISING RATES

	ONE YEAR	HALF YEAR	ONE ISSUE
Full page.....	\$50.00	\$28.00	\$10.00
Half-page.....	28.00	15.00	6.00
Quarter-page.....	15.00	10.00	4.00
One-eighth page.....	10.00	6.00	2.00

For the back outside cover add 50 per cent to the above
rates. For the inside covers add 25 per cent to the above
rates.

Address all communications to
Douglas Anderson, Editor, Tulane University,
New Orleans, La.

Application for entry as second-class matter at the Post Office at
New Orleans pending.

LOUISIANA ENGINEERING SOCIETY

OFFICERS FOR 1916

President, SAMUEL YOUNG, 1002 Perrin Building.
Vice-President, A. T. DUSENBURY, 236 Baronne Street.
Secretary, W. T. HOGG, Tulane University.
Treasurer, E. H. COLEMAN, 920 Hibernia Building.

DIRECTORS.

W. B. GREGORY, Tulane University.
OLE K. OLSEN, 822 Perdido Street.
L. C. DATZ, United Gas & Electric Eng. Corporation,
Birmingham, Ala.
R. S. MANLEY, 301 Q. & C. Building.

STANDING COMMITTEES

On Technical Papers

W. B. Gregory
A. M. Lockett
Chas. W. Okey

On Library

A. M. Shaw
E. H. Coleman
B. S. Nelson

On Publications—Division "A"

Douglas Anderson
J. M. Robert
W. T. Hogg

On Publications—Division "B"

W. H. Williams
A. T. Dusenbury
R. B. Quincy
John Riess
G. A. Seaver

On Membership—Division "A"

Ole K. Olsen
James S. Sharp
G. W. Lawes
H. E. Crump
R. S. Manley
Chas. M. Kerr
L. H. Guerin

On Membership—Divison "B"

Alfred Raymond
T. L. Willis

On Employment

H. Kokosky
Chas. J. Hardy

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

All business communications should be addressed to W. T. Hogg, Secretary,
P. O. Station 20, New Orleans, La.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. II

AUGUST, 1916

No. 4

CONTENTS

EDITORIAL NOTES AND COMMENT:	PAGE
The Density Rule	181
Wood Block Paving	183
The A. S. M. E. Boiler Code	184
The M. I. T. Celebration	186
Fees for Engineering Service	187
A Wide-Awake Engineering Society	188
Civilian Engineers in U. S. Navy Yards.....	189
William von Phul	190
 PAPERS AND DISCUSSION:	
The Density Rule for the Grading of Select Structural Yellow Pine Timber. <i>By John E. Rhodes</i>	191
Creosoted Wood Block Pavement. <i>By F. P. Hamilton</i>	196
Discussion	208
Uniform Boiler Code. <i>By W. H. P. Creighton</i>	220
MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.....	225

EDITORIAL NOTES AND COMMENT

The Density Rule.—Standardization is the order of the day, and the paper by Mr. John E. Rhodes, published in this issue, puts before us the problem of securing a definite and easily applicable standard for judging Southern pine timber. The solution of the problem as arrived at by the Southern Pine Association, of which Mr. Rhodes is the Secretary, has come in the adoption by the Association of what is known as "The Density Rule."

As has been well known for a long time to engineers and contractors and as was further brought out in the interesting discussion of Mr. Rhodes's paper, there has been a pressing need for some fairly simple and definite rule which could be used for the specification of structural pine timbers. The long used terms, long leaf, short leaf and loblolly served fairly well

in the early days of lumbering operations in the South when pine timber was so very plentiful that long leaf was the only kind of timber it was necessary to consider,—there was so much of the long leaf that the lumberman, so to speak, could treat the other specimens with silent contempt. The other various terms used in specifying timber, such as "Grades A, B, C," "merchantable," etc., have also gradually come to have very little meaning, for as the extensive lumbering operations are decreasing the supply of the highest grade of trees, Grade A timber of the present, for example, does not have the same significance as it did twenty years ago. It was also further brought out in the discussion, and this is a fact well known to the botanists, that it is impossible by a mere inspection to tell the difference between timbers cut from the different kinds of pine. The only accurate method is by a microscopic examination.

While it is recognized that the density rule would be thoroughly dependable as a measure of the strength of the timber, there still remains another important point to be determined, and that is how far the density rule would serve as a measure of the durability of the wood against the processes of decay. Mr. Rhodes stated in his discussion that experiments had been made and were still in progress for the determination of data on this important point, and while so far there has been made only a preliminary report on the subject, the data seems to indicate that of two specimens of timber of the same quality as measured by the density rule, the short leaf specimen appears to be less resistant to the processes of fungus decay than the long leaf.

One other important matter connected with lumbering operations in the South, which was not touched upon in the paper or in the discussions, and, of course, there was no reason why it should have been in a paper dealing with the specific problem of the density rule, is the question as to what extent such influential bodies as the Southern Pine Association are interesting themselves in the problem of reforestation. We feel sure that the members of the Louisiana Engineering Society

would be greatly interested in a paper or papers from the engineers of the Southern Pine Association dealing with this important topic.

Wood Block Paving.—The use of wood for paving streets has appealed to municipal engineers from early times, as pointed out in Mr. Hamilton's paper on Creosoted Wood Block Paving. It has a number of points in its favor, such as the ease of securing the material, facility of working and handling it, comparative simplicity of repairs, and its noise reducing character. The larger European cities have always been very extensive users of wooden pavements as compared with American cities, and the writer has been in the habit of attributing this in his own mind to the desire to have a type of pavement which would reduce to a minimum the noises of the street traffic. Comparing cities like London and Paris with cities such as New York and Chicago, one of the most striking characteristics of the former is the great amount of vehicular traffic as distinguished from the traffic carried by surface cars running on tracks of their own. Some years ago this traffic was all horse drawn and the problem of reducing the noise of the hoof beats of the horses and wheels of the vehicles was one of the very highest importance, and the wood block pavement offered a most excellent solution; furthermore, its resilient and elastic character made the strain upon the animals much less severe. And while now the automobile is rapidly eliminating the horse from city streets, and the above noted considerations are of not the same importance as formerly, still the wood block pavement holds its own as a prime favorite in European cities, and is making tremendously rapid strides in its use on the streets of American cities. New Orleans has probably used about as wide a variety of paving material as any city in the country, her earliest use of wood for paving purposes consisting of the between the rails pathway of boards which furnished the straight and narrow path to guide the one-mule motive power of our original street railway system, and of a section of one square of wood block paving on Common street, between Baronne and Dryades. This latter

pavement consisted of cypress blocks cut across the grain of the timber of approximately circular shape; it was quite an amusing sight at times of heavy rains to see this block of pavement rise up from its foundation (if it had one) and float gently around until the receding water deposited it back into place again with varying degrees of accuracy of register, which resulted sometimes in leaving a large portion of the pavement on top of the sidewalk.

Mr. Hamilton's paper discusses the methods of manufacture of the blocks, the character of foundation for the pavement, and the best methods of laying. After the reading of the paper some very interesting moving pictures were shown, which depicted in a most interesting way the story of the wood block pavement through all the different operations, from the time the trees were felled in the forest to the actual placing of the blocks in the pavement.

The constantly increasing use of the automobile is giving rise to another problem in paving which is now exercising the ingenuity of highway engineers. In the thickly settled communities of the East and the Middle West the question of the proper material for paving roadways between towns and cities has become a very difficult one, for the reason, apparently, that the heavy high-speed automobile produces an amount of wear and tear upon the roadways which none of the older systems of paving seem to be able to stand up under. In certain portions of New England the highway engineers are paving their roadways with solid concrete. How well this will stand the severe conditions imposed by high-speed automobile traffic remains to be seen. This kind of traffic presents a problem rather different from that of the city street, in the fact that on these highways in certain sections of the country the automobile traffic is very heavy and at the same time the average speed of running is very much greater than that on the city streets.

The A. S. M. E. Boiler Code.—At a recent meeting of this society a resolution was passed endorsing the Boiler Code of the American Society of Mechanical Engineers. Elsewhere in

this issue appears a short statement concerning this boiler code as well as some remarks made by Professor Jacobus, President of the A. S. M. E., at one of the recent meetings of the Louisiana Engineering Society. Professor E. W. Kerr of the Louisiana State University has had introduced into the present session of the Legislature a bill authorizing the Governor to appoint a Commission to draw up rules relative to the construction of boilers in this State. Wherever the Federal Government has jurisdiction the laws controlling the construction and inspection of steam boilers are very strict, but for boilers constructed and operated under the laws of many of the States, not only is there a very great diversity in these laws, but the rules and regulations themselves are often very lax or are not rigidly enforced. These conditions demand, therefore, not only more definite rules, but also that the rules for the different States be made more uniform. To bring about these conditions is the work which the American Uniform Boiler Law Society has set itself to do, under the able and efficient direction of Mr. Thos. E. Durban, Manager, Erie City Iron Works. The necessity of such laws for the proper protection of life and property are strikingly illustrated in the following statement of facts recently made by Mr. Durban:

...“Explosions of steam boilers in the United States are between four and five hundred yearly; the number of killed by such explosions is from five to six hundred, and the injured from two to three thousand, and the property loss above a million. The compiled statistics show that for the year 1914 there were 575 explosions in the United States and 315 people killed, and 476 people seriously injured. These statistics are from the record of boiler insurance companies, and of course are by no means complete, as there are a vast number of boilers in this country that are not insured, and undoubtedly a great number of serious explosions which are not of record. For this same period of time in Germany, with a population of 62,000,000, and where there is more commercial activity than in the United States, and consequently more boilers used, there were eight explosions and two were killed, two seriously

injured, and seven slightly injured. This is entirely due to more careful supervision over steam boilers."

"Statistics show us that in boilers examined last year there were 313,000 defects found, 43,000 of which were serious, 3,000 were dangerous, and 1,800 boilers actually condemned and thrown out as being unfit for use."

The M. I. T. Celebration.—The following note from President Young is published here as an acknowledgment of the courtesy shown by the "Tech" Alumni to the Louisiana Engineering Society for their invitation to Mr. Young to attend the very interesting event in which the possibilities and powers of the modern long-distance telephone were so strikingly illustrated:—

TECH CLUB CELEBRATION.

On Wednesday evening June 14th the Alumni of Massachusetts Institute of Technology celebrated in various cities of the United States the fiftieth anniversary of the founding of that great institution of technical education.

This was also the occasion of the dedication of the new location on the Charles River and of the splendid new buildings, which have cost about seven million dollars.

The large telephone companies of the United States, many of whose employees are Boston Tech men, joined in this celebration and placed a certain number of their wires at the disposal of Tech Alumni for about an hour and a half. At every place at the banquet table there was a telephone receiver and the local manager of the Cumberland Telephone Company told us that about fifteen thousand of these receivers were connected with thirty-five cities of the United States outside of Boston. We could hear distinctly conversations between San Francisco and Boston, and likewise between Boston and the various other cities on the circuit. We could hear the speakers in Boston and also the applause of the large audience there.

In this day and time we are more or less inclined to take, even unusual achievements or occurrences, as a matter of course, and nothing seems very wonderful unless one stops to think it over.

I dare say that if the Angel Gabriel were to suddenly appear on the streets there would presently be no lack of men to walk up and shake hands and inquire when he arrived and where he was "stopping." Thus are we prone to lose sight of the marvelous phenomena of Creation and of man's ability to adapt them to his use.

To the writer, who was invited to this celebration as a mark of courtesy to the Louisiana Engineering Society, it was a wonderful experience, one which he enjoyed to the fullest extent, and he was glad of an opportunity to express his appreciation, both in behalf of Louisiana Engineering Society and for himself, personally.

SAMUEL YOUNG.

Fees for Engineering Service.—The important question of the amount of fee to be charged for engineering service, and the further question as to whether there should be adopted some uniform system regulating fees for such service, are matters that have occupied the attention of individuals as well as engineering societies for some time. According to a statement in a recent issue of the *Engineering News*, a Canadian society of engineers, known as The Association of the Alumni of the Ecole Polytechnique of Montreal, has recently issued a code of professional ethics and a list of fees to be charged for different kinds of service.

For a simple consultation the remuneration is to be at the rate of \$50.00 to \$100.00 per day, based upon a six-hour day, the amount of the remuneration depending upon the reputation and experience of the particular engineer. For fractions of a day the charges are:—\$30.00 to \$60.00 per half-day; less than a half-day, \$15.00 to \$25.00 per hour.

For work requiring written reports, whether preliminary study, examination of project of another engineer, preparation

of deposition before a court, presence in court during trial, and such like service, \$50 to \$100 per day for the first five days, and \$25 to \$50 per day for the succeeding days. In addition the client shall pay salaries of assistants and an additional amount equal to 100% of such salaries to cover overhead expenses of the office.

While the working day of the engineer is to be six hours, when the work calls him from his home city, he is to receive remuneration for each day of absence whether he is actually engaged upon the details of the work or not.

The statement is further made that in some cases an engineer is justified in charging a percentage of the actual cost of the enterprise under consideration. For preparation of a project or for examination of a project of another engineer the charge shall be 2% of the possible cost of the enterprise, if this total is not more than \$50,000, the minimum fee to be \$200. For projects costing from \$70,000 to \$100,000 the percentage is to be 1½%; for projects costing more than \$150,000 the percentage is to be 1%.

On the same general basis of total cost the charges for preparation of designs for construction shall be respectively 3%, 2½% and 2%.

When complete supervision of the work is included the charges shall be respectively 7%, 6% and 5%.

A Wide-Awake Engineering Society.—The interesting and progressive activities of the Cleveland Engineering Society are well known to many of us, so it becomes of further interest to hear something of their most recent plans for development and growth. At their recent annual dinner there were present 310 members. Plans were announced by the new president-elect looking toward the raising of a fund of \$200,000 for the purchase of a permanent home for the society, and also for a large endowment for the library.

A campaign for membership carried on during the second week in May resulted in the addition of over 300 names to the roll of the society, so that the total membership is now 1,130.

These figures seem large when compared with what we are doing here in our own society, but when we take them relatively, it will be seen that the Louisiana Engineering Society shows up well. With a total membership of 240 we had over 25% of them out at our last annual dinner. And while it may seem like an ambitious dream, there is no reason why our society may not look forward in the future to the time when, keeping step with the growth and development of this city and community, we may be able to secure a home of our own with some of the features of a club to make it more attractive and more accessible. Looking backward ten years, how many of the members of that time would have predicted that we would some day be publishing our own journal and be so pleasantly quartered as we now are in our new rooms at the State Museum? Our Membership Committee has recently sent in a list of names which will add considerably to our numbers, and there is still work to be done along these lines.

Civilian Engineers in U. S. Navy Yards.—The following communication is self-explanatory, and is published here for the information of members of the Society:—

Washington, June 21, 1916.

To Commandants of all Navy Yards:

SUBJECT: Registration of civilian engineers at Navy Yards.

1. The following extract is quoted from an unofficial letter of the Engineer Officer of the Navy Yard, New York, to the Bureau of Steam Engineering:

“Two high-class engineers in New York City, engaged in work which is allied with ours, have asked me to find out if there was not some way in which they could be registered to come into the Yards in case of war as assistants to the heads of departments. These men are of middle age and for the most part are consulting engineers on marine work, and one of them made the suggestion that it looked as though it would be a good thing for all hands if they could register for certain yards and then once a year spend ten days on duty in the yards, just preparing them-

selves for an emergency. One of these men is a \$25,000 man outside, and it opened up a new field of view for me."

2. The Secretary has authorized the registration at the various navy yards of such civilian engineers, who, from the nature of the work on which they are now engaged, might be of use in an emergency.

3. The Secretary further directs that the Bureau of Navigation be furnished from time to time with a list of the names of the civilians who may register.

(Signed)

W. S. BENSON.

William von Phul.—It is with no small degree of regret that we note the recent departure of Mr. von Phul from New Orleans. He goes to San Francisco, where he has been appointed Vice-President and General Manager of the United Railroads of that city. For several years he has been a member of the firm of Ford, Bacon & Davis, with headquarters in New Orleans, and he has been associated with the firm since 1907.

Mr. von Phul is a graduate of Tulane University and received some of his early practical training in electrical engineering here with the old Southern Electric Company and with the Edison Illuminating Company. He has been an active member of the Louisiana Engineering Society since 1908, and a valuable contributor to the pages of this journal. While giving expression to our regret at his departure we wish at the same time to bid him God-speed in his new field of labor.

PAPERS AND DISCUSSIONS

THE DENSITY RULE FOR THE GRADING OF SELECT STRUCTURAL YELLOW PINE TIMBER.

By

JOHN E. RHODES

(Read before the Society, May 8, 1916.)

Mr. President and Gentlemen of the Society: In the first place, I want to thank you for the honor paid to the Southern Pine Association in inviting Mr. Hamilton and myself, and Mr. Jones, our Chief Inspector, to be with you this evening. We consider it a very great honor indeed.

The Southern Pine Association is composed of the manufacturers of yellow pine lumber in the Southern States, all the way from Florida to Texas. Louisiana is the state of largest lumber production in the South, and second only to Washington in the whole United States, and a very close second, indeed, to Washington. The production of lumber, cypress and yellow pine, in Louisiana, in the year 1915, was two and a half billions of feet. I notice on this map here that the Museum contains a shaded portion of the State of Louisiana showing the standing pine. The chances are that in 1916 the production of lumber in Louisiana will surpass that of any other State in the Union, and the greater part of it is yellow pine. This lumber is marketed all over the United States, east of the Rocky Mountains, and shipped as far north and east as Maine. Louisiana contains some of the largest sawmills, and of the best, anywhere, and a very great proportion of the prosperity and occupation of the people is incident to the lumber business. The lumber consuming public of the United States is very much interested in the recent adoption by the Yellow Pine Manufacturers of the so-called density rule for the grading, the scientific grading, of structural timbers, and in order that I may not appear before you under any false pretenses, I desire to say that I am neither an engineer nor a lumberman, although I have been directly and indirectly associated with the lumber business nearly all my life; and in presenting the density rule for the grading of select structural

yellow pine timbers, I am obliged to do so entirely from the standpoint of the theorist, and not from any practical experience with the application of this rule for the grading of the timber. The rule was adopted by the Yellow Pine Manufacturers about the 1st of March of this year.

It has been recognized for a good many years by both manufacturers and consumers of Southern yellow pine that a constructive and simple method for classifying the various grades of yellow pine for structural purposes would find wide application and fill a long required need.

The three botanical species of yellow pine, namely, long leaf, short leaf and loblolly, frequently intergrade so far as their density is concerned, and much misunderstanding has resulted because of the lack of a practical method for determining whether any particular class of yellow pine was adaptable for the purpose intended.

A vast amount of yellow pine timbers have been sold for long leaf which were not of that species.

It has been impossible to make satisfactory and absolutely correct inspection in the usual course of lumber business for the determination of species; the only absolute method is by microscopical examination, which involves too much labor and expense for general use by lumbermen.

Realizing the necessity for the determination of the strength bearing qualities of the various types of timber, the United States Forest Service undertook a series of tests calculated to establish the fact that the strength of yellow pine is dependent upon its specific gravity, which in turn is governed by its content of resin. The Forest Service proceeded upon the theory that any grading rules which it might recommend, based upon this premise, should be simple, while at the same time they should exclude all material that should not be used in mill construction with the fibre stress recommended for the grade. It was found from extensive tests that the strength of wood depends upon its density of growth, defects and moisture content, and as the specific gravity of dry weight increases the strength also increases in a fairly uniform manner.



U.S. DEPARTMENT OF AGRICULTURE
OFFICE OF PUBLIC ROADS AND RURAL ENGINEERING
L.W. PAGE, Director

STORM TIDES

Along the Central Gulf Coast

Chas. W. Okey, Senior Drainage Engineer
Prepared under the direction of
S.H.M. Crory, Chief of Drainage Investigations

1916

SCALE OF MILES



U.S. DEPARTMENT OF AGRICULTURE
OFFICE OF PUBLIC ROADS AND RURAL ENGINEERING
L.W. PAGE, Director

STORM TIDES

Along the Central Gulf Coast

Chas. W. Okey, Senior Drainage Engineer
Prepared under the direction of
S.H.M. Crory, Chief of Drainage Investigations

1916

SCALE OF MILES

High Water of Sept. 20, 1909
High Water of Aug. 16, 1915
High Water of Sept. 29, 1915
All elevations in Louisiana and Mississippi, and
all elevations of Light Houses, except as noted, referred
to Mean Low Water. All elevations in Texas
referred to Mean Low Water on local gauge of U. S.
Engineers.

The factor of density is determined by making use of the varying proportions of summer wood and spring wood, or the hard and dark annual rings as compared with the light and soft rings of the different timbers.

Numerous tests also show that in the heavier and stronger materials the contrast between the summer and spring wood increases in proportion to its strength. It was therefore decided to establish as the requirement necessary to comply with the rule one-third summer wood in the annual rings, providing the requirements as to certain other defects were met.

In estimating the density of summer wood it would be manifestly impractical from the standpoint of time for an inspector to consider a whole cross section in the larger size timbers. It would also be impossible in a large number of cases for him to accurately estimate the summer wood in the whole portion of the piece on account of the fineness of the rings. To surmount this difficulty it was decided to use, for estimating the summer wood, the zone including 3, 4 and 5 inches from the center of the timber. This portion is the most easily measured or estimated and invariably represents the entire cross section. Measurements were made on 200 trees selected by the Forest Service in various places in the South. The proportion of summer wood in the 3, 4 and 5 inches averaged about the same as the proportion of the summer wood in the whole cross section, and few trees showed any marked difference, so it is apparently entirely just to use 3, 4 and 5 inches from the center as the criterion of the cross section of the entire stick.

The density requirement for first grade material then becomes one-third summer wood in the 3, 4 and 5 inches from the center. Modifications for this requirement in the Grading Rules are provided for where the pith or center is not contained in the stick measured, or where the material is comparatively a small cross section.

Summarized, the requirements for superior quality structural timbers commercially designated as "dense" Southern yellow pine embody: sharp and distinct lines of demarkation between summer wood and spring wood; the proportion of these growth rings showing at least six annual rings per inch and at least one-

third summer wood, or else the greater number of rings shall show at least one-third summer wood, as measured from the third, fourth and fifth inches of a radial line from the pith.

Wide ring material not coming within this rule may be accepted, providing the amount of dark summer wood be one-half or more.

Parenthetically it may be said here that some, through selfish motives, have sought to evade the explicit requirements of the density rule by counting the individual rings of summer and spring wood as indicating total annual growth—that is, one ring of either representing a year's increase; whereas as a matter of course one ring of spring wood and one ring of dark summer wood taken together should be counted as one year's growth.

It will be noted that this measurement of strength makes no distinction between the botanical species of Southern yellow pine. The tests have shown as a matter of fact there is no difference whatever in strength qualities when the material shows the required density growth. Hence it is entirely possible for timbers of short leaf or loblolly pine to possess the measure of strength requisite for ordinary structural uses, although, of course, timbers of these varieties coming within the requirements of the density rule may be said to be exceptional. As for the application of the strength measurement to long leaf timbers, it is not unusual for such material to show a density of growth much in excess of the requirements of summer wood and the number of annual rings to the inch.

The dependability of this measure of strength was thoroughly established by the Forestry Department before it was given publicity. The findings immediately were seized upon by the American Society for Testing Materials, which had already devoted much study to the problem of accurately grading structural timber for strength qualities, and that representative organization, after a thorough analysis of the rule, gave it its formal adoption as standard. The engineers of the Southern Pine Association also quickly recognized its practical value, and placed their endorsement on it. The simplicity of application and dependability of the rule has since won the unqualified

approval of many of the foremost structural experts of the country. The rule has been accepted and indorsed recently by the Illinois Society of Architects, by various building code commissions, by the New Orleans Dock Board, and by the United States Navy Department. Through the publicity given the new rule through the advertising of the Southern Pine Association in technical journals, it has been brought to the attention of architects and engineers throughout the country. And it has been enthusiastically received by professional builders everywhere as providing the first scientific and accurate method ever devised for determining with ease and certainty the actual dependability of Southern yellow pine timbers required to sustain definite loads.

In a word the Density Rule removes Southern yellow pine structural timbers from the class of speculative material and provides a measure of strength value that eliminates guesswork. It strips specifications of confusing and ambiguous descriptive phraseology as to species and trade terms, and briefly yet comprehensively limits the character of material to the requirements of the user.

That the Density Rule should appeal strongly to the architect and engineer is not remarkable—it is a guarantee that their specifications will be carried out. When a structure fails because of faulty material it is inevitable that the designer more frequently than not comes in for blame, no matter what may have been the real cause of the trouble. The uncertainty attending the use of timbers in the past has more than once established a prejudice against their use, and instances where, had the element of uncertainty of quality been removed, every consideration of economy, adaptability and service naturally recommended the use of timbers. How welcome, then, must be the simple, effective and accurate standard of measurement of strength by which the designer of a structure may protect himself from future criticism because of failures due to materials lacking in the qualities they were reasonably expected to possess.

CREOSOTED WOOD BLOCK PAVEMENT.

By

F. P. HAMILTON.

(Read before the Society, May 8, 1916)

"Of all inventions, the alphabet and printing press alone excepted, those inventions which abridge distance have done most for the civilization of our species."

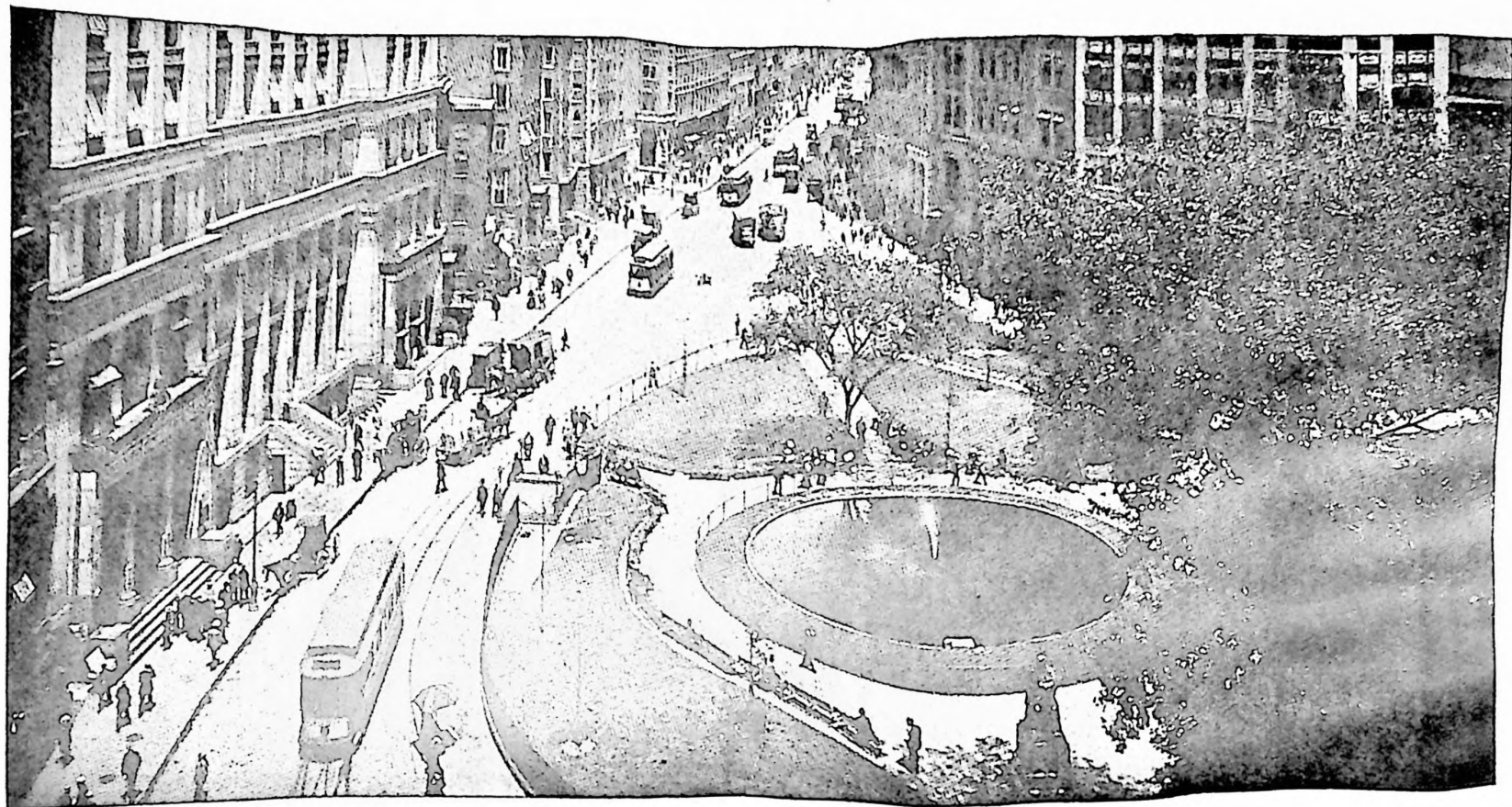
Lord Macaulay made no specific reference to that material which is now so generally conceded to be the best aid in abridging distance.

The Appian Way was built of stone by the Romans about 300 years B. C. The first wood pavements are said to have been laid in Russia several hundred years ago and were blocks of hexagonal shape, but not much is known of them as no detail record has been found.

Wood, however, has been used for abridging distance perhaps since the civilization of man. You are all familiar with the corduroy road and the plank road. Streets have been entirely graded and paved in sawmill towns with sawdust, and still other roads have been made by piling logs along the roadway and burning them into a semi-charcoal and then spreading the charcoal and grading it.

As far as records show, the first wood pavements for city streets were laid in New York in 1835. In 1839 Philadelphia laid some hexagonal hemlock in Chestnut street, and square spruce in Third street. In the same year London began the use of wooden blocks bedded in gravel. In 1841 round beech blocks set on plank were tried. Wood paving was introduced into Paris in 1859 and on January 1st, 1909, they are said to have had 2,400,000 square yards of this material. The average life of the blocks, which were soaked in a hot bath of fat oil, supposed to contain about 13% creosote, was eight to nine years.

In 1848 the Nicholson pavement was patented in America, and much of it was laid prior to 1870. The specifications being for either white pine or Southern yellow pine. The blocks were rectangular in shape and were dipped in pitch just before being placed in the street. The foundation was made by grading the



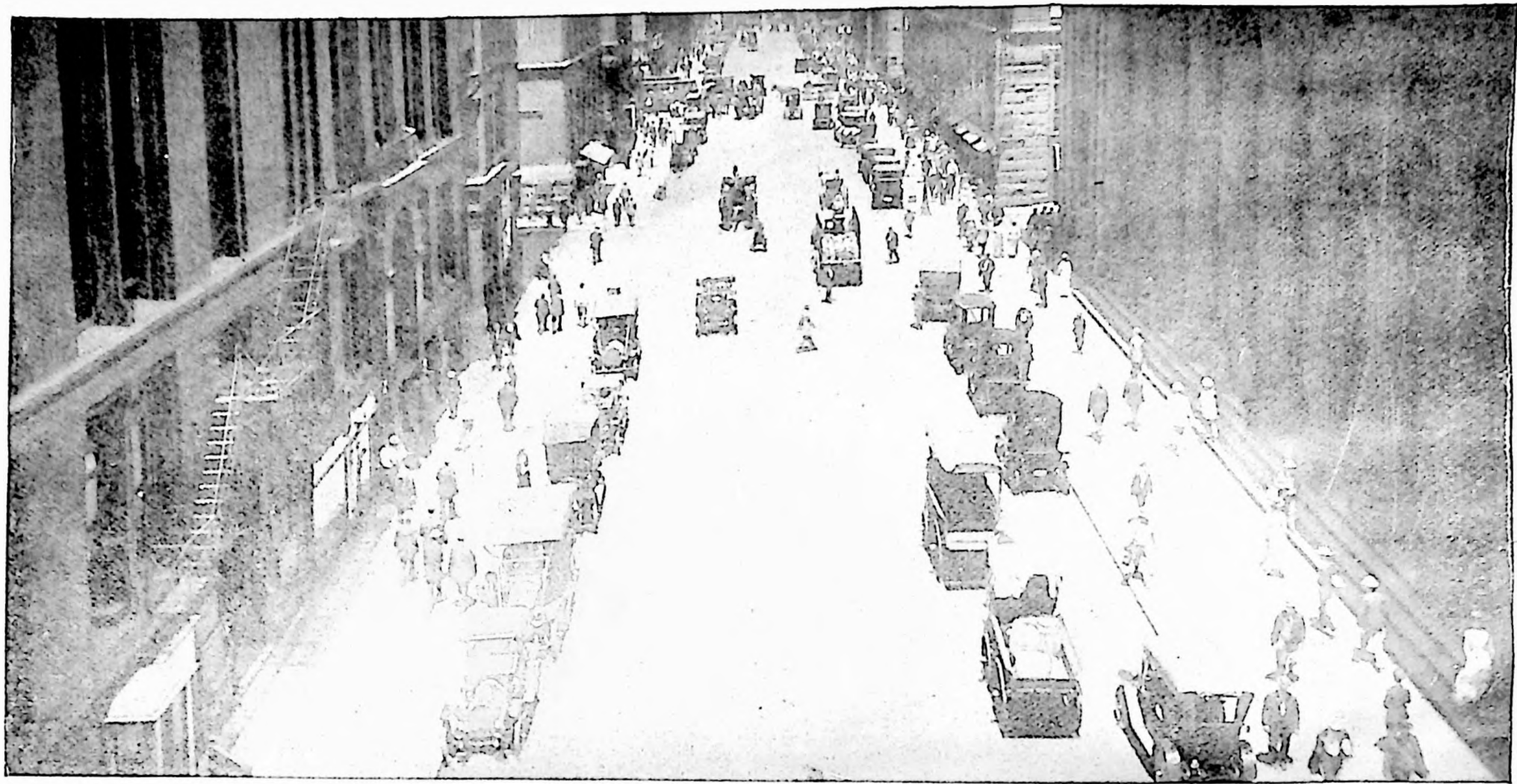
BROADWAY AT BOWLING GREEN, NEW YORK.

street, spreading several inches of sand, and in this bedding pine boards transversely and at such intervals as to permit of jointing over them, a layer of one-inch pine boards laid longitudinally, and covering the entire street area. These planks were all painted on both sides with pitch and the paving blocks placed directly on them. The evil effects of this type of pavement are still felt. In 1881 the City of Washington had in use 1,088,000 square yards of wood pavement laid under twelve different patents. In 1889 it had all disappeared.

Following the Nicholson pavement came untreated cedar blocks, of which millions of yards were used in Western cities from 1880 to 1890. Various other woods were tried, cypress and cottonwood being among the number. These were round in shape and were set either on sand, gravel or plank, and some were set on concrete with a sand cushion. Cedar blocks were used in Chicago, St. Louis, Minneapolis, Omaha, Detroit, Kansas City and many smaller cities. On January 1st, 1897, Chicago had 752 miles of cedar block pavement laid on plank foundation. This was replaced by various other materials, and the other materials replaced with the modern creosoted pine blocks.

In 1874 Galveston laid 75,000 yards of creosoted pine blocks, and they gave excellent service until destroyed in the storm of 1900. The blocks were treated with 8 to 10 pounds of creosote and laid directly on the natural sand. Others of the same type were laid in 1892-94 and may still be seen in the streets and in fair condition.

Some one has very aptly said that "Foundations are to pavements what floors are to carpets." It was about 1872 in London that the use of concrete foundations was begun and the blocks were set in mortar. From that time to the present wood block pavements have played a prominent part in municipal improvements, or in abridging distance, in Europe and America. Many experiments have been tried and many improvements made until we arrive at the modern creosoted pine block, "The Royal Pavement." There is at the present time about two million yards of creosoted wood block in London and Paris each. Since the modern wood block pavement was first laid in 1899 in Baltimore, 1900 in Boston, 1902 in New York, Minneapolis and St. Louis,



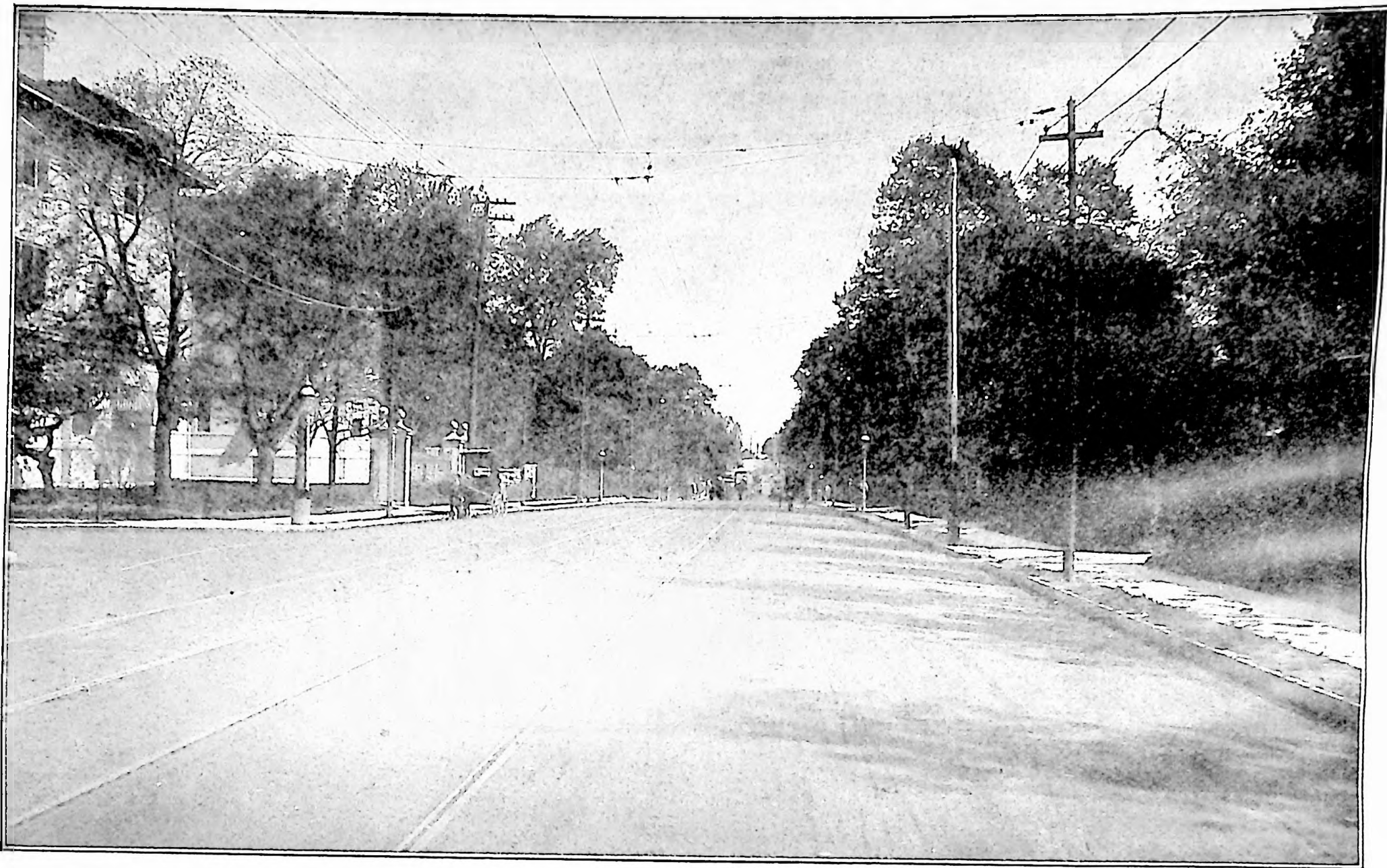
LA SALLE STREET, CHICAGO.

its use has increased until at the present time there is in use in the United States more than fifteen million square yards; Minneapolis alone having 1,556,000 square yards on the first of January and they have bought 350,000 square yards for use in 1916. This material is being used in such sections of congested traffic as lower Broadway in New York and the loop district of Chicago, and on such boulevards as Reading Road in Cincinnati, Washington Boulevard and Westminster Place in St. Louis, Tenth street in Minneapolis, and on hundreds of other streets, both residence and business, and with both heavy and light traffic in our largest cities and most progressive villages.

Before paving a street the engineer should carefully study present conditions and what may be reasonably expected for a number of years. Paris spent \$14,000,000 in improving the Rue de Rivoli and London spent \$33,000,000 in improving the Strand, and the material used for paving in each case was creosoted wood blocks. The first point to be considered is the width of paved-way. We hear a great deal about heavy and light traffic, but these terms have little meaning with reference to street traffic. What might be considered very heavy traffic on a road 30 feet wide, would be light on one 60 feet wide.

As a general proposition the width of paved-way on residence streets without car tracks should not be more than 30 feet, and 18 feet is enough to permit a vehicle standing at each curb and one passing between. Even with a car track, 28 feet gives ample room for one car and two vehicles to travel abreast. For business streets without car tracks 30 to 40 feet is generally ample. By narrowing the roadway your available funds will extend the pavement much farther and abridge more distance. If the total street width is great you can throw traffic so much farther from your front door and beautify the remaining space with trees, flowers and grass.

Drainage should be carefully and amply provided. When the street gradient is one per cent, or more the problem is very simple, but even perfectly level streets can be amply drained by using a few extra inlets and sewer pipe. Curb exposure can be varied from a summit at the center of the block to inlets at each



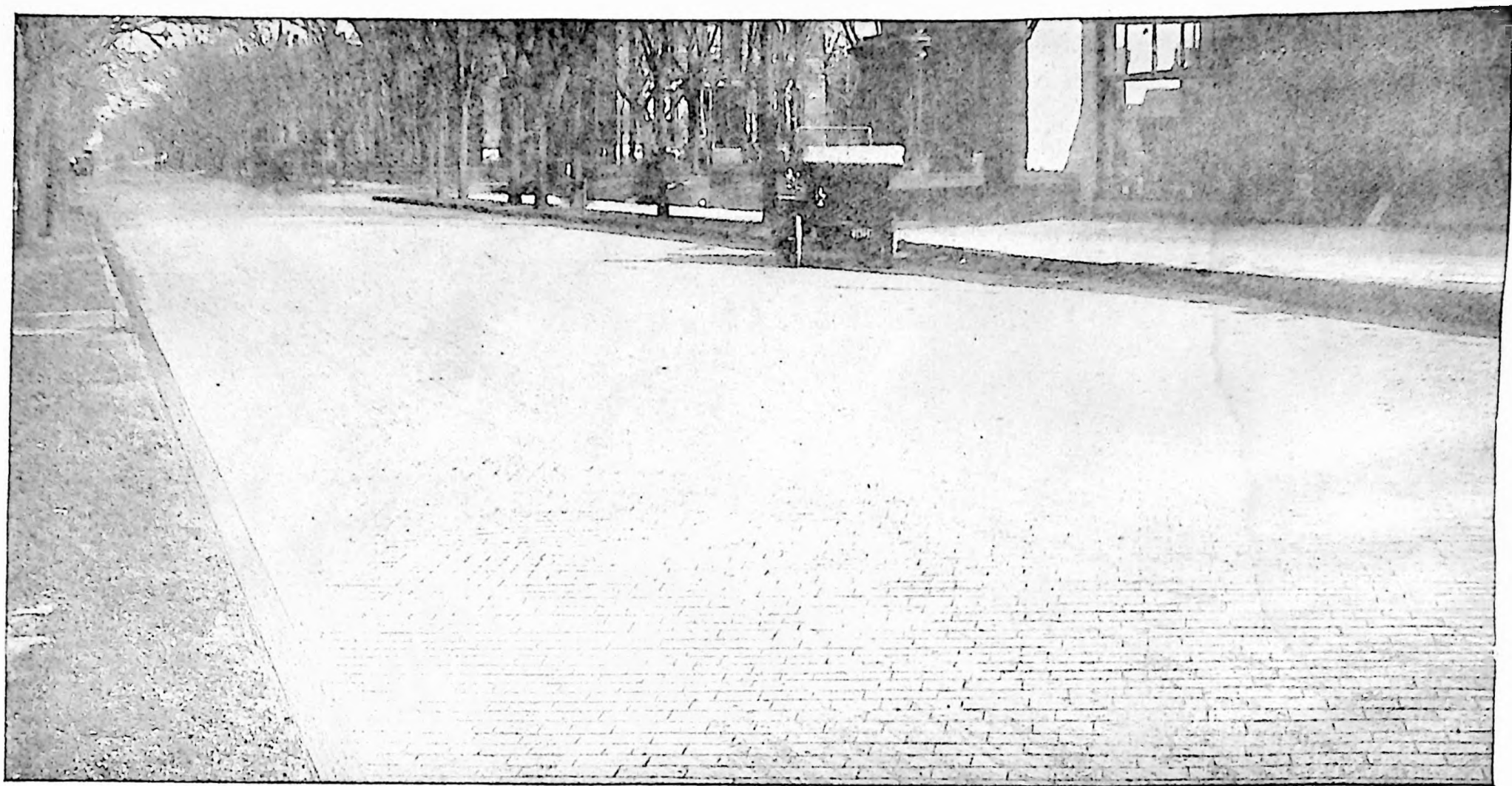
READING ROAD, CINCINNATI.

end, or from summits at each end to inlets at the center. The center line of roadway can be perfectly level and the variation in curb exposure hardly noticeable.

The crown of the street from gutter to center should be as little as possible, and the smoother the pavement the less the crown. The form of street crown is generally a parabola, and the rise should be for wood block pavement from one to three per cent of half the paved width. For a street 18 feet wide, I would say 3%, and for one 100 feet wide 1½%. Excessive crown induces slipping sidewise of animals as well as automobiles, and is the cause of a great deal of the slipperiness of smooth pavements. In the case of wood block all heart-wood is more slippery than where a considerable percentage of sap is used.

The concrete foundation should be of such thickness as the local engineer may determine from soil and traffic conditions. It should be mixed wet and floated to a fairly uniform surface. This can be done so as to vary not more than one-half inch from the true contour without extra expense.

After the concrete has set sufficiently it should be covered with a surfacing coat of about ½ inch thickness. This coat to be composed of one part Portland cement and four parts sand. This mortar should be very thoroughly mixed and spread dry, and should be well sprinkled with water immediately ahead of the block laying. It has been asked whether a dry mixture can be called mortar. Webster's definition of mortar is: "A building material made by mixing lime, cement, or Plaster of Paris, with sand, water, etc." Technical works refer to various kinds of mortar but none specify any definite amount of water required to term the mixture mortar, so for want of a better word we say mortar. The word "cushion" is a misnomer. It was formerly believed that "sand cushion" was really a cushion and shock absorber, but we all know that thoroughly compacted and confined sand is very unyielding. Furthermore, we know now that if a wood block can be firmly bedded in place and kept there, that there is little chance of splitting, while if the block is allowed to shift about or move up and down, there is danger of splitting. The "mortar cushion" is an equalizer and bed, and enables us to firmly bed each block in position with a solid bearing. In roll-



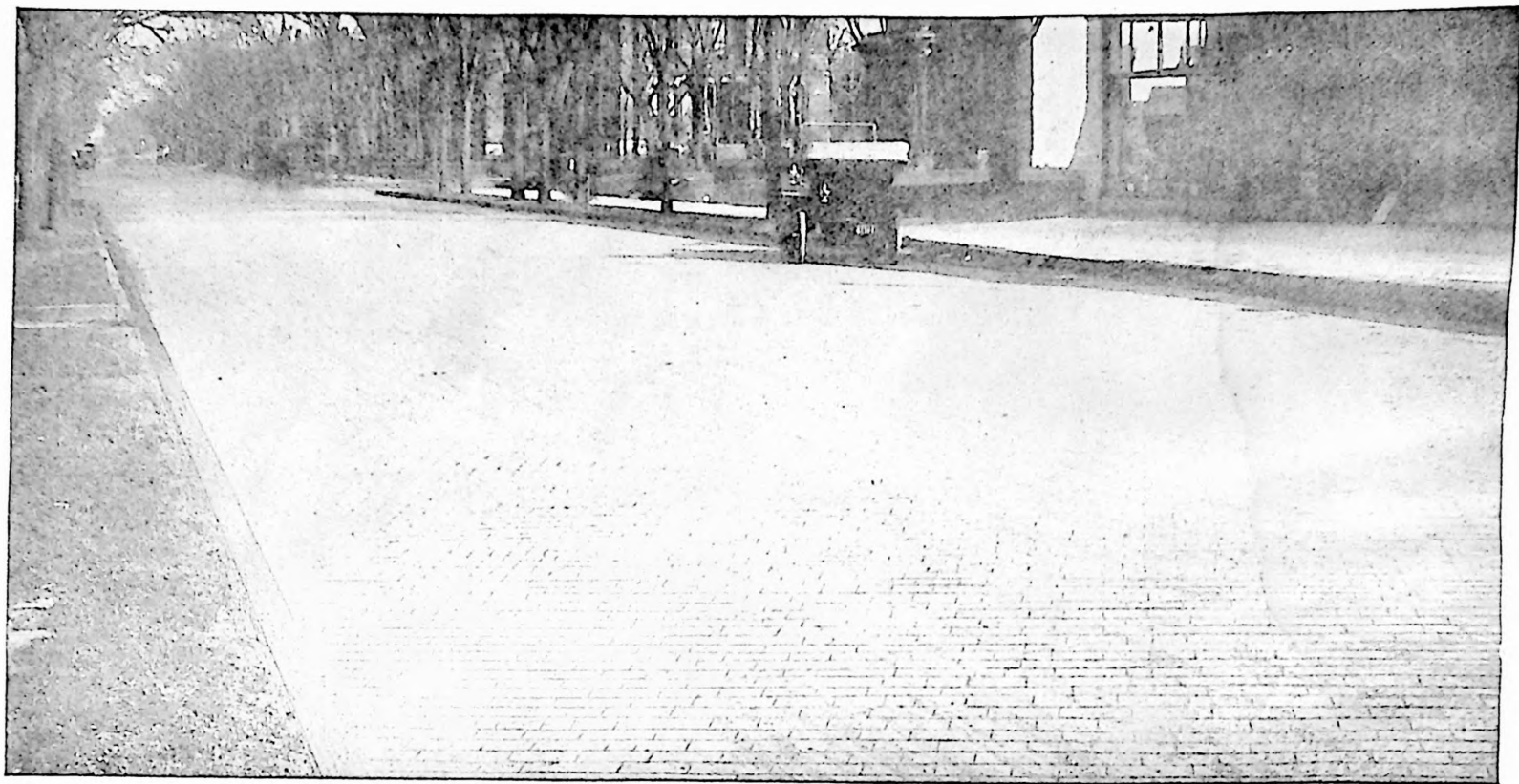
TENTH STREET, MINNEAPOLIS.

end, or from summits at each end to inlets at the center. The center line of roadway can be perfectly level and the variation in curb exposure hardly noticeable.

The crown of the street from gutter to center should be as little as possible, and the smoother the pavement the less the crown. The form of street crown is generally a parabola, and the rise should be for wood block pavement from one to three per cent of half the paved width. For a street 18 feet wide, I would say 3%, and for one 100 feet wide 1½%. Excessive crown induces slipping sidewise of animals as well as automobiles, and is the cause of a great deal of the slipperiness of smooth pavements. In the case of wood block all heart-wood is more slippery than where a considerable percentage of sap is used.

The concrete foundation should be of such thickness as the local engineer may determine from soil and traffic conditions. It should be mixed wet and floated to a fairly uniform surface. This can be done so as to vary not more than one-half inch from the true contour without extra expense.

After the concrete has set sufficiently it should be covered with a surfacing coat of about ½ inch thickness. This coat to be composed of one part Portland cement and four parts sand. This mortar should be very thoroughly mixed and spread dry, and should be well sprinkled with water immediately ahead of the block laying. It has been asked whether a dry mixture can be called mortar. Webster's definition of mortar is: "A building material made by mixing lime, cement, or Plaster of Paris, with sand, water, etc." Technical works refer to various kinds of mortar but none specify any definite amount of water required to term the mixture mortar, so for want of a better word we say mortar. The word "cushion" is a misnomer. It was formerly believed that "sand cushion" was really a cushion and shock absorber, but we all know that thoroughly compacted and confined sand is very unyielding. Furthermore, we know now that if a wood block can be firmly bedded in place and kept there, that there is little chance of splitting, while if the block is allowed to shift about or move up and down, there is danger of splitting. The "mortar cushion" is an equalizer and bed, and enables us to firmly bed each block in position with a solid bearing. In roll-

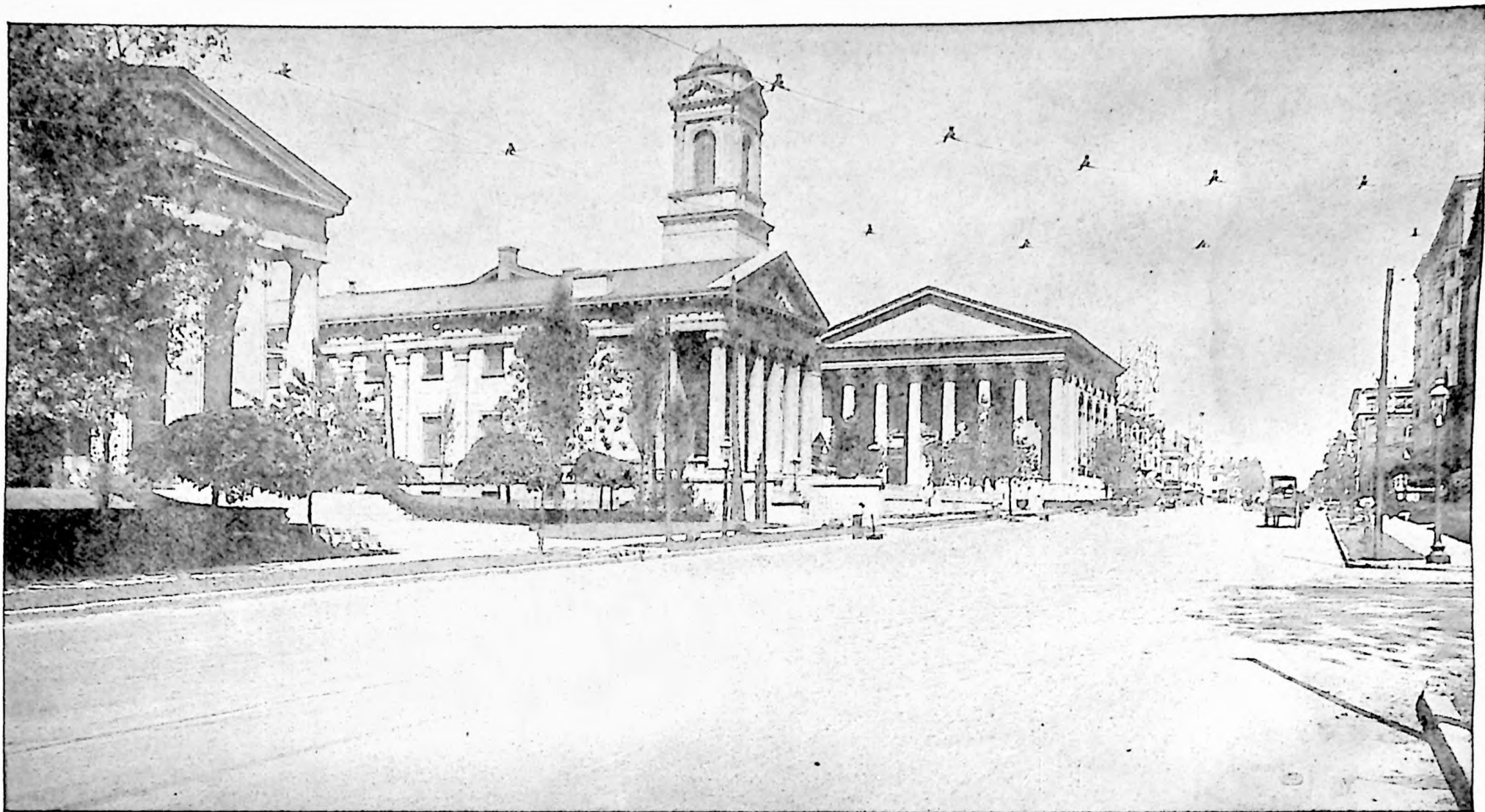


TENTH STREET, MINNEAPOLIS.

ing the wood block surface, which should be done before the mortar cushion has begun to set, a small amount of the mortar is forced up between the blocks and this helps to hold them in place. The sand cushion formerly recommended shifted through the effects of vibration and water, and, acting as a sponge to hold water, was largely responsible for the buckling of wood block pavement. In London and Paris wood block pavements are laid directly on the dry concrete foundation or after painting the foundation with pitch. I do not think this construction as good as the mortar cushion. Unless the concrete is very carefully troweled the blocks will not be solidly bedded and are liable to split. For paving between street railway tracks I think that a fairly wet mortar should be used and the blocks tamped into it. Setting blocks in the wet concrete foundation would give good results if it were not so hard to put into practice. If the concrete is made dry enough to work on in laying the blocks it is well nigh impossible to make it smooth enough to get a good smooth surface, and there is great danger of not having a firm bedding of the blocks or that some blocks will rock on pebbles or stones and eventually split. It is also impossible to get as dense a concrete as where the wet mixture is used.

It is universally conceded now that Southern yellow pine is the best material for paving blocks. The timber should be cut from live standing trees, should be square edged and free from unsound, loose, or hollow knots, knot holes, worm holes, or other defects which would be detrimental to the life of the blocks. The number of annual rings measured radially should not be less than six to the inch. The coarse grain pine does not resist shearing or splitting, nor does it take creosote treatment near so well as the close grain pine. Blocks should be from three to four inches deep, and only in cases of very heavy and congested traffic is more than $3\frac{1}{2}$ inches needed.

In America the amount of treatment is almost standardized now at 16 pounds per cubic foot of timber. Various amounts have been used in the past, varying from three to twenty-four pounds. It has been found by experiment that five pounds of creosote oil is sufficient to preserve the wood against decay, and the balance is for water-proofing. Specifications are in use now

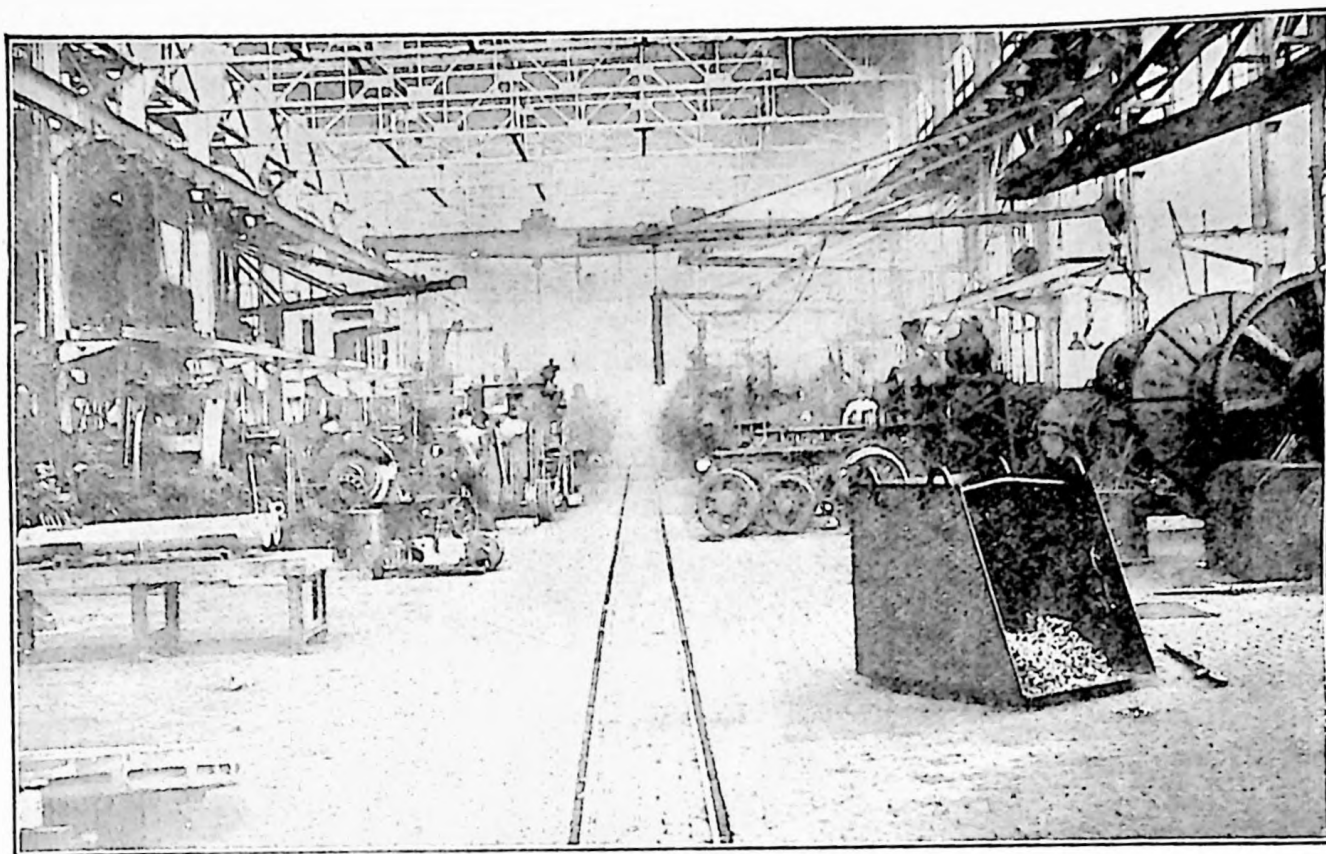


KINGSHIGHWAY, ST. LOUIS.

where only 12 and 14 pounds of oil are specified and excellent results are being obtained. In London and Paris the present day treatment is 10 pounds. Where the atmosphere is constantly damp and the blocks always expanded this seems to be ample, but where long alternate wet and dry seasons are encountered a heavier treatment is desirable. The kind of oil to be used is still a mooted question. There are many advocates of a mixture of creosote with filtered tar, and I prefer this oil where the tar is limited to 25% of the mixture. On the other hand, I believe that excellent results can be obtained with a pure distillate creosote, but I think that the creosote should be of high specific gravity, 1.06 to 1.08. With the creosote tar mixture the specific gravity should not exceed 1.12.

The most serious objection to wood block pavements in the past has been the "bleeding" or exuding of oil from the blocks after being laid in the streets. Various theories have been advanced but the Forest Products Laboratory at Madison, Wisconsin, and The Kettle River Company at Minneapolis, have both arrived at practically the same solution of this vexing problem, and blocks can now be treated with either sixteen or twenty pounds of straight distillate creosote or creosote-tar mixture without bleeding. The method is simple and consists of steaming and high vacuum through a comparatively long period, or until all sap is removed from the wood, then a slow treatment, and after this a final vacuum, and if necessary to clean the blocks, final steaming. At the end of treatment the blocks must contain the required amount of oil. Instead of certain pores or cells being full of oil and others only partly filled, this treatment insures a thorough penetration and painting of the inner fibers and a well preserved non-bleeding block.

The next step is to fill the joints of the wood block pavement after it has been well rolled or tamped, with a hot bituminous filler. There is as yet no evidence to prove that either coal tar pitch or manufactured asphalt has any advantage the one over the other. If pitch is used it should be of such consistency as not to become brittle in cold weather nor to run in hot weather.



CENTRAL OF GEORGIA RAILWAY SHOPS, MACON, GA.

A melting point of about 145 degrees F. seems to answer. If asphalt is used it should have a melting point of about 175 degrees F. In either case the material should be heated to and poured at about 300 degrees F.

With good pine blocks, laid on a good foundation, with mortar cushion and bituminous filler as outlined above, you will have a pavement which will not only abridge distance, but will defy time and the elements and prove itself durable, noiseless and economical.

6

DISCUSSION.

MR. RHODES: Mr. Chairman, I might say that in the discussion of this matter, Mr. J. Jones, Chief Lumber Inspector of the Southern Pine Association, is here by invitation, and will be very glad, indeed, to answer you any questions concerning the application of this rule. As I stated in my remarks, we are not engineers, and will not be able, possibly, to give you much of the information offhand concerning questions of construction. This we can get for you, however, if you desire. But we are familiar with the application of this rule in relation to structural timber.

THE PRESIDENT: Gentlemen, before proceeding with the general discussion of these papers, we would like to hear from Mr. Jones, the Chief Inspector of the Southern Pine Association.

MR. JONES: I did not know, gentlemen, what would be expected of me, therefore I came down entirely unarmed and I am at your mercy. Mr. Rhodes has very ably covered the use and origin of the density rule, and I will not undertake to supplement that at all, but I would like to say a few words in regard to the structures here.

(Mr. Jones illustrated his remarks by means of diagrams on the blackboard and by reference to a display board containing specimens of yellow pine timber.)

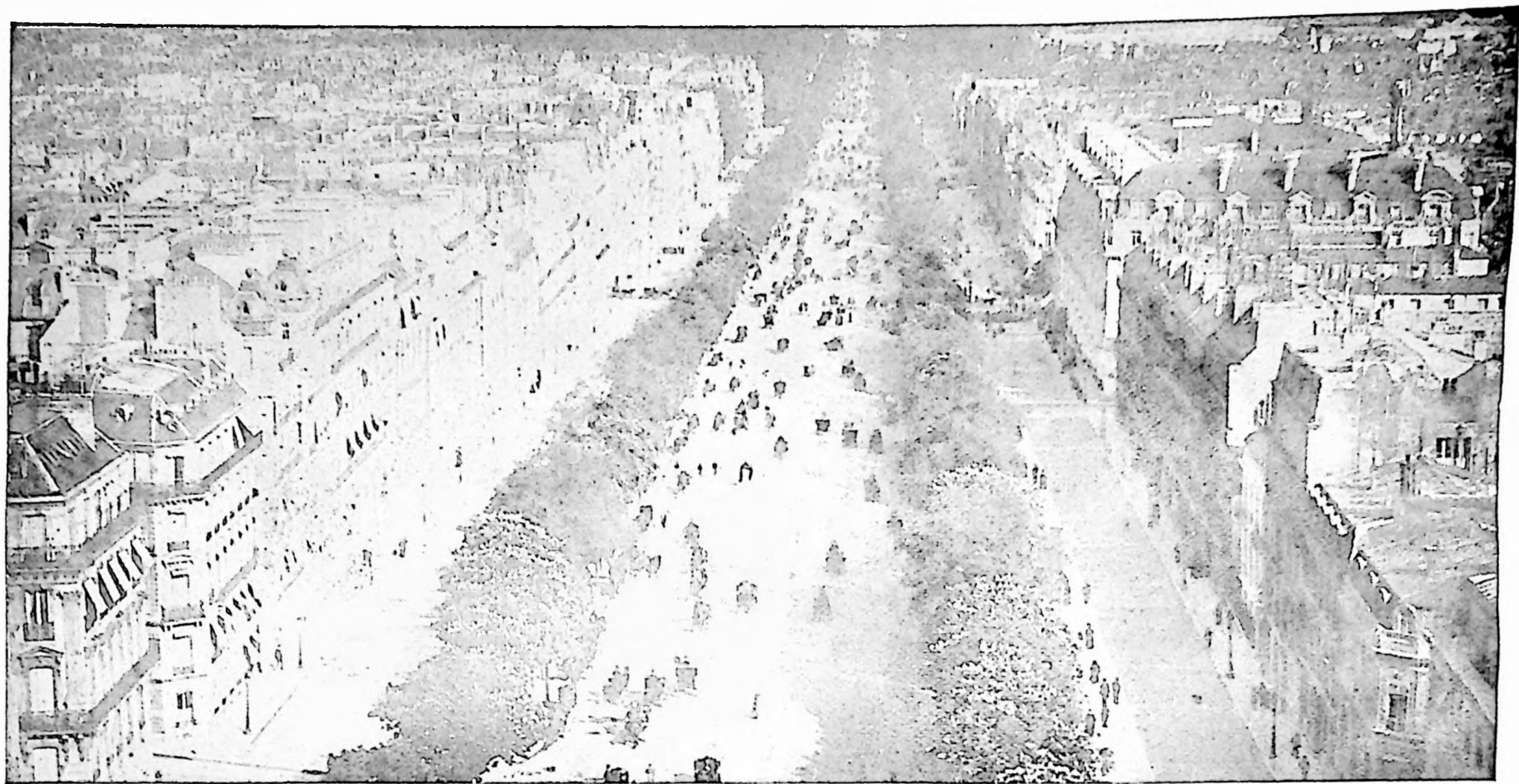
Here is a piece representing select structural material as recommended by the Forest Service, and it is divided into three volumes of the center half, consisting of volume 1, volume 2 and volume 3. Volume 1 is the lower section, one-quarter of the center half of the stick of timber, and in that is the main strength



REGENT STREET, LONDON.

of the timber. The defects contained in volume 1 have the greatest bearing on the strength of the timber, and should not contain defects or knots, properly speaking, exceeding one-half the cross-section of the face of the timber, and the maximum diameter of a knot in that should not exceed one and a half inches; in volume 2, it should not contain a knot exceeding 2 inches in diameter, or one-half the cross section of the face—the maximum size of the knot, 2 inches; and the aggregate diameter of all the knots in the center of the half of any face should not exceed the width of that face. I think it has been decided—you gentlemen are all mechanical engineers, and you know a great deal more of the stress value than I do—but I believe it has been decided that knots in this portion of the timber are really of value in the timber more than anything else—it does not add strength to the timber, but prevents shearing to a great extent. The quality of the knots is the next thing to be considered. A knot such as this, while it does not weaken the timber at present, leaves an opening in the timber that will allow the elements of decay to enter, and therefore, should not be admitted in select structural material. We have here what is a perfectly sound knot, except with a deep hole, and we don't know what that leads to; it may not go very deep, but it is restrictive. Here is an unsound knot,—we all know what that is. Encased knots, while they do not detract from the strength of the timber, allow the element of decay to enter, and should not be admitted. The next thing to consider is the shake. The shake is of the greatest moment when it is in the middle height of the vertical face, as it allows shearing. Is there any question you would like to ask about the density rule? I would be glad to answer it, if possible, but, as I said before, I came unarmed, and I am entirely at the mercy of you gentlemen, and trust you will be merciful.

MR. COLEMAN: I would like to ask one question, which is not quite admitted through the doorway that has been opened for questions, but as a matter of information, with respect to the value of the timber as to durability. I think it is almost self-evident that the density of the timber is an accurate gauge by which its strength may be measured, but the density may or may



CHAMPS ELYSEES, PARIS.

not be a rule by which to measure the decay, and I would like to know if you possess any information on that particular line.

MR. JONES: No, really, I do not have any specific information. The element of preservation of the timber is contained in the pith or resinous substance, and that can only be decided from a laboratory process, and it is a rather lengthy and expensive operation. We have never gone into that.

MR. COLEMAN: The point I had in mind is this: Under the density rule provided for the highest grade of timber, there are six annual rings per inch, in the third, fourth and fifth inches, in which case you admit one-third summer wood, or, for less than six annual rings per inch for those three inches, you provide for 50 per cent summer wood, with a lesser number of rings. Now, it is manifest that in the lesser number of rings, where it runs to three or four rings per inch in the three inches, even with a 50 per cent summer wood, that the spring wood rings,—which I have always called pith rings—which intervene between the resinous rings, are much wider rings, and I have always had the idea that these pith rings were the part of the timber which was most susceptible to decay. Therefore, if that be true, which is merely an idea of mine, if these pith rings are comparatively considerable in their cross-sectional area, it would seem that there would be greater likelihood of decay in the timber which had wide rings of pith than in the timber which had very narrow rings of pith between the resinous rings, between the summer wood rings, and it is on that line I wanted information, if possible.

MR. JONES: Well, that might be possible, but the element of preservation, as I stated before, is contained in the summer wood; yet, it is bound to have its effect on this spring wood. They are so closely allied that there cannot be an element in one that does not affect the other; and the greatest strength is in the summer wood, and it is the portion of the timber that contains the resinous substance which is the preservation of the timber. And where there are less than six rings to the inch, the summer wood must be at least 50 per cent; therefore, you have really

more summer wood, or more wood containing the rot-resisting element than you had in six rings with only $33 \frac{1}{3}$ per cent summer wood.

MR. WILLIAMS: With reference to Mr. Coleman's question, take a piece of loblolly with six rings, and a piece of long leaf with six rings.—one amount of summer wood in each,—under the density rule, it would have the same strength?

MR. JONES: Yes.

MR. WILLIAMS: Would it have the same lasting quality?

MR. JONES: That is one of the questions I cannot answer, really. It is generally supposed that long leaf has the greatest rot-resisting element of all the Southern pine timbers, but the laboratory people at Madison, Wisconsin, have put through numerous tests with regard to that very question; that has only recently begun, and it will be quite a good while before definite information can be arrived at with regard to that question.

THE PRESIDENT: Gentlemen, we would be glad to hear from any one who has some ideas on either one of these papers. They are both subjects which are interesting to all engineers and architects.

MR. RHODES: I might say, for the information of you gentlemen, that the Southern Pine Association, under the direction of Doctor Von Schrenck, of St. Louis, is conducting experiments to determine the very points that you raise. The doctor has some four hundred specimens, possibly more, of the three species, and of varying density, which are being subjected to tests to determine the resistance of the fungi, dependent upon the density content. Those experiments have been under way now about a year. We had a preliminary report about two months ago, and there will be another in eight or twelve months, giving the final result, and they really did show that the loblolly which was affected with the same supposedly relative amount and character of fungi with which the long leaf and short leaf were inoculated, was entirely gone, and it was quite evident from the preliminary report, and similar observations of those outside, that the short leaf had been less resistant than the long. We will give the Society the result of these tests when the report is completed, of course.

MR. JACKMAN: Mr. Jones, is there any density rule to determine long leaf from short leaf and from loblolly, taking the diameter of the pith and the number of rings a certain distance from the pith in consideration?

MR. JONES: There was something like that, but that is a matter which I have not studied,—there was a plan of that kind, or rather, an effort made to determine the long and short leaf pine by the size of the pith. But in my experience I do not consider that absolutely infallible, for the simple reason that I have seen sticks of timber with pith at one end not more than one-sixteenth of an inch in diameter and at the other end more than three-sixteenths inch in diameter.

MR. JACKMAN: But in this rule for determining the species of pine, the diameter of the pith is taken into consideration with the number of rings; in some cases the pith would be large, but that would be compensated for by the number of rings?

MR. JONES: I am not sure of that, sir.

MR. HAMILTON: There was such a thing as that published in the *Engineering Record* last summer.

MR. JACKMAN: Is there any rule for determining from the timber, after it is cut, whether it is long leaf, short leaf or loblolly?

MR. JONES: I have been in the business twenty-five years, and I have not been able to determine that. I do not think it can be determined, except by a laboratory process. I do not think any man can possibly tell, even to a remote degree of certainty, as to the long leaf or short leaf pine.

THE PRESIDENT: I will state, for your information, Mr. Jackman, that year before last, I think, Professor Cocks, of Tulane, gave us a paper on the different species of yellow pine, and he says it is absolutely impossible to tell one species from the other except under the microscope, by observing the texture of the wood; that you couldn't tell by any other method.

MR. SHAW: There is one question brought up, or point brought up, by the speaker, in which he stated they anticipated considerable trouble in dealing with the mills, in getting them to adopt this new method of grading timber, and they were pleased to find that they met with less opposition than they expected. I

think possibly that can be explained to a certain extent in the following way, without desiring to detract in any way from the excellent work which has been done in this new method of grading, by recognizing the fact that the principles of this method have actually been in practical use by a great many mill men and timber buyers for a number of years, without knowing the real road they were heading for. As engineers, we have been writing in our specifications, when we wanted a certain grade of timber, that the timber should be long leaf Southern yellow pine, and we were fortunately situated so that the men on the job would actually go to the mill and inspect that timber personally, or through an able representative, and they would pick out what they would consider long leaf yellow pine, usually without much discussion on the matter from the mill men and the better grade of mills; and when especially high grade timber was required, we found a great deal of co-operation on that line. It may be we didn't get long leaf or short leaf, but we got what we were after. So I think the greatest work has been in establishing a standard with which can be definitely worded the character of timber we have been trying to get for a number of years for the highest grade of material.

MR. O'REILLY: I would like to ask Mr. Hamilton something. I would like to know how those rings should be measured, how to determine whether there should be an average of six annual rings in every inch, or should they be measured in some other way.

MR. HAMILTON: In answer to that, I will read the following: "The number of annual rings in each one inch, which begins two inches from the pith of the block, shall not be less than six measured radially, provided, however, that blocks containing between five and six rings in this inch shall be accepted if they contain 33 1/3 per cent or more of summer wood. In case the block does not contain the pith, the one inch to be used shall begin one inch away from the ring which is nearest to the heart of the block."

MR. GARSAUD: Relative to the inspection of timber, yellow pine, and speaking of the contractors now, one of the statements I have enjoyed most this evening, and for which I think the

contracting profession in this city ought to thank Mr Jones, is the statement that after twenty-five years experience, he could not tell by mere observation the difference between loblolly and long leaf. That particular sort of inspection has lead some of us, sometimes, into very deep argument, and I think it is a statement that has been made just in time, because I, for one, as an engineer and contractor, have always taken the position--and I think some of my friends here will bear me out--that you could not tell the difference by looking at it, and of course, they naturally took the other side. So I was very glad to hear a gentleman of so many years actual experience in that particular line make that statement.

MR. COLEMAN: I have been very much interested in the paper that has been given to-night on the density rule as to the specifications of timber, and more particularly as it has lead these authorities who have established such a rule to a conclusion which is in line with the conclusions that my own mind had lead me to, though not to so great a distance. Some years ago, I had the misfortune to specify, in a certain piece of work I had control of, long leaf yellow pine of a certain grade, and to reject timber that was delivered under the specifications, of which I was the author, on the ground that it was not long leaf yellow pine. I received the same jolt which several of us seem to have received to-night here, by the claim on the part of the timber men that I could not tell long leaf yellow pine from short leaf or loblolly without a microscopic examination, which I realized in advance I was not capable of making. I went so far as to go into the woods with their representative and to have trees cut down which were manifestly long leaf pine and which showed the same characteristics that I had diagnosed as short leaf pine in these rejections, and I then discovered what has been stated to-night, that we could not depend on classification as between long leaf and short leaf and loblolly on the arrangement or the number of rings in the timber. Since that time I have been writing in my specifications the words "close-grain yellow pine," without reference to whether that close-grain yellow pine should be long leaf or short leaf or loblolly. Now, a mere specification calling for a close-grain timber has been to me, unsatisfactory in many de-

tails, for the reason that it did not specify what a close-grain was, and in those few instances in which I have had a controversy with the timber people as to what constituted close-grain pine, I found more or less difficulty in sustaining my own position to my own satisfaction, in the determination of what close-grain yellow pine really consisted of, how many rings to the inch. My first information with regard to this density classification was obtained about six weeks or two months ago, in correspondence with another engineer, and also in the preliminary bulletins which were issued by the American Engineering Association, giving full warning of the fact that they were about to consider at that time laying the foundation for the adoption of this standard of classification for Southern yellow pine. After going through the descriptive matter on this subject with considerable care, I felt the same degree of enthusiasm for the specifications proposed, which seems to have infused itself into these gentlemen who have been kind enough to come here to-night and explain in detail the density classification and how it was arrived at. And I felt that while we might possibly sacrifice something in dropping the words "long leaf" from our specifications, because of the possibly greater durability of the long leaf pine, I did not feel we were sacrificing very much, for the reason that after everything is said and done, we would have to use a microscope to tell whether the pine is long leaf yellow pine or not, and we certainly will arrive at a state of affairs in which we can at least calculate with more certainty the supporting power of beams, columns and other members entering into the construction work, under the density classification, than has been possible under "Grade B," or "Merchantable," or other classifications by which timber has been known in this territory. Incidentally, a state of affairs will be brought about which will render impossible the misfortunes which have come to some of our brother professionals when there has been an argument or discussion as to what a particular grade or particular piece or particular lot of lumber actually measured up to. We all, no doubt, have a keen recollection of the controversy that attained considerable publicity some three years ago, where an engineer, a member of this Society, had accepted a considerable quantity of material

under the local classification known as Grade "B," and where other inspectors took issue with him as to whether that material actually came within the grade stipulated. There are perhaps as many as three or four different ways of interpreting the definition of that grade, as written, as to the material that was in question, and I do not think anybody ever changed his mind as to what that material really was. Those that thought it was Grade "B," to start with, still think so, and those that did not think it was still do not think it was Grade "B." With any such accurate classification of lumber as is set forth in this density method, I think many of our minor troubles, as well as a great number of our major troubles, in the use of timber for structural purposes, will disappear.

MR. PRESIDENT: Mr. Black, I think you have studied this question a good long time. We would like to hear from you.

MR. BLACK: I have nothing to say, except that there is one other point we may be able to bring out, and that is whether there is any specific difference in the composition of the three grades of wood which might have a stable effect on the life of the wood, and as to what has been done in the way of research bearing on this point.

MR. RHODES: This also is a point that we have investigated, and on which we have no definite results up to this time. It is thought that there is a slight difference. The laboratory at Madison is also going into that. Our Association is not conducting the experiments on that particular phase of it. Whether there is a difference, or whether the difference in the resin in the different species will have any effect on the lasting quality of the wood, is also to be determined. It is thought by several authorities that it would have, but from the lumberman's standpoint, it is a very minute and indefinite problem that has not faced us yet, and that, too, will probably be worked out. That is a matter which has been recently taken up by the lumbermen, and taken up with enthusiasm, and in a year or two I suppose that will be developed and brought out to their own satisfaction.

THE PRESIDENT: Any one else wish to discuss either one of the papers we have heard, either as to the density rule or the creosote block pavement? We have here copies of the density

rule, or a reprint from the American Society for Testing Materials, with articles and photographs by representatives of the Forest Service, with very clear and definite descriptions of the applicatoon of the rule. You may have that if you wish.

A MEMBER: Can you say if a piece of timber has been tapped, whether it alters its strength?

MR. RHODES: The Forest Service has found that it does not affect the strength of the piece.

UNIFORM BOILER CODE.

B--

W. H. P. CREIGHTON.

Laws should render equal justice to all. The user, seller and maker of boilers should be protected in their rights. Laws should not deter nor tax business unnecessarily and yet that is bound to occur if the laws are not changed to harmonize with the advance in the arts. And we know that a highly specialized knowledge is necessary to understand the laws governing the composition and characteristics of the materials entering into the construction, design and fabrication of boilers, and hence it is difficult to obtain necessary changes in boiler laws. As an actual fact, probably no two States of the United States have the same laws on matters dealing with boilers. In some States there has been no change in the boiler laws for so many years that they are more honored in the breach than in the observance, as compliance with them would be absurd. Is this desirable?

Fully cognizant of all these conditions from actual experience, Mr. Durban, Superintendent of the Erie Iron Works of Erie, Pa., thought that it would be of service to the community if there could be laid down a code of laws on boilers, boiler materials and apparatus that would be adopted by all the States as their code. An improvement on this was to have a society such as the A. S. M. E. adopt a code that could be altered from time to time to suit changing conditions and have the code, as soon as it was revised by the society, become the new State code. Before such a code could be devised there would necessarily be numerous consultations with those interested in the manufacture of steel, rivets, and other material entering into the construction of boilers and with those manufacturing safety valves, safety plugs, valves and other adjuncts of boilers. The code of the State of Massachusetts was taken as a guide, and after a large amount of discussion and numerous compromises a code has been finally drafted which, while not perfect, is of remarkably high grade. This code is now supported not only by the American Society of Mechanical Engineers but has also the support of the Master Boiler Makers' Association and of the Rivet and Steel Makers' Association.

In all the discussions, Mr. Durban took the part of the man using steam boilers who wants a thoroughly reliable boiler which can only be obtained when soft ductile steel and high grade rivets are used in a design correct in each detail. Great credit is due Mr. Durban for his altruistic spirit in spending time, money and energy in a matter of prime importance to every factory owner. In addition, many members of the American Society have unselfishly devoted much energy to the devising of the code, especially its President, Mr. Jacobus.

The advantages of the present code are:

(1) It is a vast improvement on any code in any State, has the support of all interested parties, and has been adopted in several States.

(2) It is to the interest of the maker of boilers, as he can send a stock boiler to any State without having to make alterations to suit some legal vagary of that State. The cost of boilers is reduced because unnecessary losses, unnecessary friction and unnecessary complication are avoided.

(3) It is better for the boiler user, as he is sure of getting a boiler that complies with code requirements, or the seller is making himself liable for obtaining money under false pretenses. If the owner is a contractor, it is an advantage to take boilers from one State to another without being required to make alterations in each State visited.

The enforcement of the code is a matter of education alone, as it is not proposed to have any drastic laws or drastic inspection service. It is expected that competition will be the main instrument for enforcing the code. Thus it is proposed to sell for \$2.50 an A. S. M. E. boiler code stamp to any reputable boiler maker who will go before a notary and take oath that he will build such a boiler as he stamps with the code stamp strictly in accordance with the code. The society reserves the right to compel him to return the stamp in case he violates this oath. Competitors and other interested persons will make it dangerous to use the stamp improperly. If a man is deprived of the stamp that fact will be thoroughly advertised, and as

boiler factories cannot be easily moved from place to place business loss is certain to occur. When the boiler user finds that he can obtain a reliable boiler, made in accordance with the code, for practically the same price that a boiler maker demands for a boiler that cannot carry the code stamp, in most cases he will seek the security and protection afforded by the stamp.

(Prof. Jacobus, President of the American Society of Mechanical Engineers, being present at the meeting at which Prof. Creighton made his statement, was invited to explain to the members some of the points of the Boiler Code. Prof. Jacobus spoke as follows:)

Mr. President and Gentlemen: Professor Creighton has put this thing before you in such a straightforward way that I want to commend him for the direct way in which he presented the subject. The Code, at first, was gotten up by a committee of five or six members, which was appointed four or five years ago. That committee worked along and made a number of reports, each time getting the report in a little bit better and better shape, and with the report they had a proposed form of inspection law and so forth. All this time that they were working, the Council of the American Society of Mechanical Engineers were feeling that they did not know exactly where this report might lead to if it was adopted by the Society, and it was also appreciated that the American Society of Mechanical Engineers, according to its constitution, had no right, legally, to accept or adopt any standard. In fact, that is very nearly the words of the constitution. It was finally agreed that the American Society of Mechanical Engineers should limit its field of action simply to the mechanical part of the code, and to getting up a code of boiler construction apart from the proposed line of inspection. They also imposed a condition on that committee, which was a pretty hard one—that they call in representatives of all of the different interests that were concerned in the code, and said that if they could get a unanimous report from all of the interests, they would consider the adoption of the code. I think there were eighteen that were brought in to represent different interests, and those eighteen interests were very widely distributed, and represented the steel men and the tube makers and a great number of different classes of boilers, threshing machines and so forth, and different societies of boiler men were

represented on that so-called advisory committee. The advisory committee then got to work with the original committee and started in to harmonize and get a report to which each one would subscribe, and get a unanimous report, and that was quite a piece of work, because we had to take and cut a little here and a little there, but finally, after one industry would say they would do this, and the others began to appreciate the magnitude of the movement, then, gradually, every one began to co-operate in getting what was considered to be the best report under the conditions, that is, a report which will not inflict undue hardship. There are certain features left out of that report that might be in it, but so far, we are happy to say there are no mistakes in the report, that is, what is in the report, we haven't found yet a real mistake, except that in the very first copy that went out there were some typographical errors, but there have been no real errors in the report. In a work of that kind, it is often difficult to express exactly what is meant, and curiously enough, the more a page is worked over the worse it becomes after we begin to analyze it closely, and the most of the questions have arisen on the pages that we worked over the hardest.

Nevertheless, when you get back to it, there are some things that can have a double meaning, so that the Council, after this report was accepted, constituted a new committee, formed of the original committee and the advisory committee, calling that committee the boiler code committee, and that committee holds monthly meetings, or thereabouts, to answer any letters that come in requesting the code, and to interpret any portion of the code. In fact, that committee has been also given power to make interpretations for constructions not covered in the code. So far, they have not had to exert that power. Everything, so far, that the committee has done has been in direct interpretation of things contained in the code. Those interpretations are readily sanctioned by the American Society of Mechanical Engineers, through being first presented to the Council of that Society in typewritten form before a meeting, and then considered at a meeting of the Council, so that the whole thing is watched over very carefully by the American Society of Mechanical Engineers. Finally, the interpretations are published in the

Journal of the Society, and in that way great care is taken that all of these interpretations shall be in the spirit of the code, and that the interpretations shall be correct. I think you all will agree respecting the necessity of a code of the sort. It is wonderful how men that will value their lives and property will run along with boilers, old boilers that may explode, and how little attention is, in some cases, paid to boiler construction, where there are so special laws; and the whole spirit of the code is to get additional safety in boiler construction, yet, at the same time, not to overstep the mark and make it so that any particular construction is discriminated against, provided that construction is safe.

As I told you, there are a few features that eventually will have to go in the code. Now, I can give an illustration of that: In the code there is nothing said about the finishing of hand holes, that is, finishing of hand hole openings; that is, they can be punched out and left that way; that is one of the things that may seem curious, but it was purposely left in there, because it would have been a great hardship with certain classes of manufacturers. And there are some other things in there of that character. The one I mentioned just now is the most important of that sort of omission in the code. But the idea is that eventually, the code will probably be a little bit stiffer, to use that sort of an expression, than it is to-day, but the whole general consensus of opinion of those who have to use the code is that the committee went just about as far as they should in getting up these rules for better boiler construction.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Society, June 12, 1916.

The meeting was called to order with President Young in the chair and 70 members and guests present.

The minutes of the previous meeting were read and approved.

There being no reports from committees, the technical exercises of the evening were held. Mr. J. W. Fairlie, veteran of the Battle of Ypres, gave a very interesting talk, narrating his personal experiences in the trenches on the battlefields of Europe. Mr. Fairlie was tended a rising vote of thanks.

Mr. A. M. Shaw moved that a Committee on Standards of Engineering Data on Reclamation Projects be appointed. The motion was seconded by Professor Anderson and carried.

Professor Gregory moved that we adjourn for July and August. The motion was duly seconded and carried.

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

W. T. HOGG, Secretary.

Regular Meeting of the Board of Direction, June 20, 1916.

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

Minutes of the last meeting were read and approved.

The following applications, approved by the Membership Committee, were ordered to ballot:

Resident Members—L. A. Beemel, J. W. Fairlie, J. McC. Fourmy, Jas. C. Moore, Gilbert von Phul.

Non-Resident Members—Jno. de M. Crawford.

Resident Associate Members—Geo. J. Glover, W. E. Wakefield.

Transfer from Non-Resident Associate to Non-Resident Member—S. W. Elbersen.

Transfer from Student to Resident Junior Member—Clifford H. Stem.

The following applications were ordered to ballot, subject to the approval of the Membership Committee:

For Resident Member, Chas. S. Williamson, Jr., Herbert M. Shilstone.

For Reinstatement and Transfer Non-Res. Junior to Resident Member—A. F. Barelay.

For Junior Member, Frederic D. King, Jr., C. Snyder.

An application for reinstatement from Mr. Will J. Gibbens was read. It was moved and carried that Mr. Gibbens be reinstated as a Resident Member upon payment of delinquent dues.

Resignation of Mr. Wm. Steckler, student member of the Society, was accepted with regret.

The matter of sending an itemized account of the expenditures on refitting the library to the Board of Curators of the State Museum was taken up. It was moved and carried that a copy be enclosed with a formal letter to the Board of Curators.

The resignation of Mr. E. H. Coleman as Treasurer of the Society was accepted with regret. After a brief discussion, it was moved and carried that Mr. John Klorer be appointed to fill the vacancy.

Mr. Young stated that the work of the Secretary had increased to a considerable extent during the past year and a half, partly on account of the increase in membership and also on account of publishing our own proceedings. It was moved and carried that the salary of the Secretary be increased from \$20.00 to \$30.00 per month, effective July 1, 1916, \$5.00 per month to be charged to the Proceedings Fund.

The following bills were approved for payment:

Tulane University Press (Printing and Postage).....	\$18.15
W. E. Evans (Moving Picture Operator May Meeting).....	2.50
Kokosky & Co. (Book on Military Preparedness).....	1.50
M. C. Le Jeune (Stenographer February and March Meetings).....	27.00
C. C. Hartwell Co. (Electrical Fixtures in Library).....	41.00
Rowland and McRedmond (Insurance, 3-year Policy).....	20.00
W. T. Hogg, Secretary (Salary and Incidentals).....	24.77
Miss Jeanne Jarreau (Stenographer for Sam Young).....	8.25
Fabacher's New Rathskeller (Refreshments May Meeting).....	7.40

The financial statements of the General Fund and Cash Fund were submitted by the Secretary and accepted. The statements showed a balance in the General Fund for May of \$32.31, and standing balance to date \$483.44, and cash on hand after all bills are paid \$138.33.

There being no further business the meeting adjourned.

W. T. HOGG, Secretary.

The Proceedings of the Louisiana Engineering Society

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

DOUGLAS ANDERSON, Editor.

The Louisiana Engineering Society is not responsible for any
statement made or opinion expressed in this publication.

Subscription, \$2.00 per annum

Single copy, 35 cents

ADVERTISING RATES

	ONE YEAR	HALF YEAR	ONE ISSUE
Full page.....	\$50.00	\$28.00	\$10.00
Half-page	28.00	15.00	6.00
Quarter-page	15.00	10.00	4.00
One-eighth page.....	10.00	6.00	2.00

For the back outside cover add 50 per cent to the above
rates. For the inside covers add 25 per cent to the above
rates.

Address all communications to
Douglas Anderson, Editor, Tulane University,
New Orleans, La.

Application for entry as second-class matter at the Post Office at
New Orleans pending.

LOUISIANA ENGINEERING SOCIETY

OFFICERS FOR 1916

President, SAMUEL YOUNG, 1002 Perrin Building.
Vice-President, A. T. DUSENBURY, 236 Baronne Street.
Secretary, W. T. HOGG, Tulane University.
Treasurer, JOHN KLOERER, 213 New Court House Bldg.

DIRECTORS.

W. B. GREGORY, Tulane University.
OLE K. OLSEN, 822 Perdido Street.
L. C. DATZ, United Gas & Electric Eng. Corporation,
Birmingham, Ala.
R. S. MANLEY, 301 Q. & C. Building.

STANDING COMMITTEES

On Technical Papers

W. B. Gregory
A. M. Lockett
Chas. W. Okey

On Library

A. M. Shaw
E. H. Coleman
B. S. Nelson

On Publications—Division "A"

Douglas Anderson
J. M. Robert
W. T. Hogg

On Publications—Division "B"

W. H. Williams
A. T. Dusenbury
R. B. Quincy
John Riess
G. A. Seaver

On Membership—Division "A"

Ole K. Olsen
James S. Sharp
G. W. Lawes
H. E. Crump
R. S. Manley
Chas. M. Kerr
L. H. Guerin

On Membership—Division "B"

Alfred Raymond
T. L. Willis

On Employment

H. Kokosky
Chas. J. Hardy

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

All business communications should be addressed to W. T. Hogg, Secretary,
P. O. Station 20, New Orleans, La.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. II

OCTOBER, 1916

No. 5

CONTENTS

EDITORIAL NOTES AND COMMENT :	PAGE
Storm Tides on the Gulf Coast.....	227
Experiences of a British Soldier.....	228
The Committee on Reclamation Data.....	229
Mr. Charles W. Okey to Leave New Orleans.....	233
A State Association of Engineering Societies.....	234
What is a Civil Engineer?.....	234
A Card from One of Our Advertisers.....	235
Creosoted Materials Company, Incorporated.....	236
New Members.....	236
Honor for a Tulane Student of Civil Engineering.....	237
PAPERS AND DISCUSSION :	
Storm Tides Along the Central Gulf Coast. <i>By Charles W. Okey</i>	238
Discussion.....	281
Personal Experiences of a Canadian Soldier in Belgium. <i>By</i> <i>J. W. Fairlie</i>	286
MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.....	302

EDITORIAL NOTES AND COMMENT

Storm Tides on the Gulf Coast.—The paper of Mr. Okey, read at the September meeting of the Society, and published in this issue forms an exceedingly valuable and important contribution to the technical literature dealing with certain engineering problems peculiar to this particular section of the country. Inspection of high tide marks were made and measurements taken where possible at many points along the coast extending from Biloxi, Mississippi, to Palacios, Texas. Similar data were collected from light stations extending from Pascagoula, Mississippi, to Brownsville, Texas. Records were made not only of the highest storm tides recorded, but other data also were noted, such as the direction of the wind, exact date of the highest water, direction of flow of the tidal water, length of time the water remained

above mean Gulf two feet, and the date and height of the previous highest water. It is interesting to note that the severest storms, those accompanied by the highest tides and causing the greatest damage to property in Louisiana and Mississippi, have occurred within the period from September, 1909, to September, 1915.

The results of these storms in the matter of damage to property have clearly indicated that many places along the Gulf Coast as well as along the shores of the coastal lakes, such as Lake Pontchartrain, must make provision for more adequate and efficient protection against the ravages of such storms than they have had in the past. Mr. Okey, in collecting his data, has borne this fact in mind with the result that he has gotten together a great deal of supplementary data dealing with such matters as the effect of the abnormal tides on structures, embankments, beaches, etc.

The value of such supplementary data was further emphasized in the very interesting discussion by Mr. Hobart D. Shaw, in the course of which he explained the methods of shore protection which were being employed under his direction in Gulfport, Mississippi. Mr. Shaw's remarks were of such great interest to the members of the Society, and the details of the work he is doing are of such great technical value that he has been requested to amplify his verbal discussion and contribute it as a paper to be published in the *Proceedings*.

The map which Mr. Okey mentions in his paper is at this date not available for publication. It makes a very large drawing and has been sent on the Department at Washington to be prepared for reproduction. When this has been done we hope to furnish copies of it as a supplement to one of the future issues of the *Proceedings*.

Experiences of a British Soldier.—While not an engineering paper in the technical sense, yet Mr. J. W. Fairlie's talk, delivered before the Society at its June meeting, was of great interest to the large number of members and guests present on that date. Mr. Fairlie detailed for us in a modest, straightforward manner all the important events in the experience of a volunteer soldier

from the time of his enlistment at his home in Canada to the time that he was wounded in battle and thereby incapacitated for further service. Mr. Fairlie's address gives an interesting insight into many of the details which must be provided for in the making of a good soldier, and his simple account of the life in the trenches in the early stages of the war brings to one a deeper realization of the terrible hardships, both physical and mental, which the soldier is called upon to endure.

In the conclusion of his address Mr. Fairlie outlined briefly the character of the interesting British organization, known as the Legion of Frontiersmen, carrying with his explanation the suggestion that possibly a similar organization in the United States might be of service in furnishing a nucleus of trained soldiers of rather exceptional ability. This Legion of Frontiersmen furnished Great Britain with ten thousand soldiers, each man of which supported himself, thus relieving the government of just so much expense.

The Committee on Reclamation Data.—The matter given below is the stenographer's report of a statement made by Mr. A. M. Shaw at the June meeting of the Society:

Mr. Chairman, the matter that I want to suggest has to do with the engineering work which is being done in this section in connection with land reclamation. This is one of the larger fields of engineering which we have to deal with in this section, and I feel that the engineers and the business interests which are back of the reclamation of these Louisiana lands are getting a rather unusual share of attention from the United States Government through the Department of Agriculture—the investigations which they are making here—and I believe it is due that Department that we coöperate with them in any way that we can, and I believe that it is on account of the coöperation which they have received that we are getting what is considered more than our share of assistance in this section from the Federal Government.

I bring this up entirely on my own initiative, but I believe that it will be very pleasurably received by the

men who are engaged in this work. I want to propose that a committee be appointed to assist in preparing a set of standard records for the reclamation projects which are now under way, which I believe will be of material assistance to the Department of Agriculture in compiling the data which is yearly becoming more valuable for engineers engaged in that class of work in this section. The work of the Government engineers in compiling the data which they are gathering, and which is being made available for this section, is arduous and extremely difficult to handle, on account of the lack of uniformity of record-keeping, and also of the failure of a great many projects to keep full records, and I think it would tend to uniformity and more complete data if the Society, or a committee with the sanction of the Society, could prepare a proper set of forms for daily run-off records, for operations of pumping plants and the like, and possibly a weekly or monthly summary of the records. With that in view, I move that a committee be appointed, which might be termed a committee on standards for engineering data of land reclamation projects. The working out of that committee, I think, might be left, that is, the result of their work might be passed on as committee work. I do not think it is of sufficient importance to call for the sanction of the Society in the formal manner which our Constitution and By-Laws call for. I think the record blanks could be prepared by that committee, and perhaps published in our Journal, or sent out as the record blanks recommended by the committee. That would probably give them standing enough, without the official sanction of the Society, or going through that formality, and I make the motion that a committee be appointed to prepare such forms.

As a result of this proposal the committee has been appointed, consisting of Messrs. Chas. W. Okey, chairman; A. M. Shaw, and A. T. Dusenbury. This committee has drawn up a standard form for keeping records and this form has been approved by the Department of Agriculture. A copy of the form is reproduced here. These forms are being printed by the De-

partment and copies of them may be secured through the local office of Public Roads and Rural Engineering. It will be understood, of course, that the person using these forms for keeping a record of his plant would be willing to furnish the local office with copies of same for the use of the Department. Arrangements will probably be made also by which the forms may be obtained through the Secretary of the Louisiana Engineering Society.

STANDARD FORM FOR PUMPING STATION RECORD

Name of Pumping Plant.....

Year....., month....., day.....

Rainfall (24 hours, ending 7 a. m.).....

Hour	Suction gauge, feet	Discharge gauge, feet	Speed of Pumps—R. P. M.			Started pump No.	Stopped pump No.	Gallons Per Minute		
			No. 1	No. 2	No. 3			No. 1	No. 2	No. 3
A. M.										
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
P. M.										
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

Wattmeter reading at start....., stop.....

Remarks:

.....
Signature of Engineer.

Mr. Chas. W. Okey to Leave New Orleans.—Mr. Okey, who has for a number of years been in charge of the local office of Public Roads and Rural Engineering of the U. S. Department of Agriculture, will shortly sever his connection with that office in order to move to South Carolina, where he will be Engineer in charge of a large reclamation project.

Mr. Okey came to New Orleans in January, 1910, as successor to Mr. A. M. Shaw, in the capacity of Irrigation and Drainage engineer for the Department of Agriculture. During his seven years of incumbency of the office he has done a very large amount of important work in connection with irrigation and reclamation projects in this portion of the country. The results of his work are embodied in a number of pamphlets which have been published from time to time by the Department of Agriculture. His office has likewise served an exceedingly useful purpose as a center of information and reference for parties who are planning to go into reclamation projects.

Mr. Okey's new field of labor will be with the Combahee Company in Whitehall, South Carolina. This company is undertaking the drainage and development of about six thousand acres of land, which will be used for diversified farming. About three thousand acres of the land have already been under cultivation for rice. The surveys and plans for the development were made last November by the Department through Mr. Okey's office, and the company let the contracts for the work during the past summer. He now gives up his position with the Government in order to take entire charge of this work in his private capacity. Mr. Okey has made a host of friends among the engineers, agricultural, and business men of this section of the country, and they will be gratified at his well earned promotion, while at the same time regretting that his new position will necessitate his removal from this community.

The work of this district will now be under the direction of Mr. Lewis H. Jones, with headquarters in Montgomery, Alabama, but the local office will be maintained here with Mr. Charles Kirschner in charge. Mr. Kirschner has for some time been assistant in Mr. Okey's office.

A State Association of Engineering Societies.—The following communication has been received from the Secretary of the Minnesota Joint Engineering Board:

The Engineers of Minnesota believe that through the coöperation of the various Engineering Societies they can be more useful to their communities, and are attempting to bring about closer coöperation through the formation of the Minnesota Joint Engineering Board. The constituent societies represented on the Board are the Northwestern Association of the members of the American Society of Civil Engineers; Minnesota Section of the American Society of Mechanical Engineers; the Minnesota Section of the American Institute of Electrical Engineers; the Minnesota Surveyors and Engineers Society; the Engineers Club of Minneapolis, and the Civil Engineers Society of St. Paul.

It is hoped that through this central organization the activities of the Engineers of Minnesota may be more closely correlated and more accomplished for the public welfare.

Geo. W. Rathjens of St. Paul is the Secretary of the Board.

What Is a Civil Engineer?—*The Monthly Journal of The Engineers Club of Baltimore* in its September issue prints this rather amusing characterization of the Civil Engineer.

CIVIL ENGINEERS.

By

GEORGE FITCH.

(With apologies to Quarterly Bulletin, Bureau of Public Works, Philippine Islands.)

A Civil Engineer is a quiet man with a thick coat of sunburn, who spends his time revising climates, editing the landscapes, and training up rivers into lives of usefulness.

In order to do this the Civil Engineer does not tear the earth wide open with 100-ton spades or perform other feats of strength. He is usually of ordinary size and if he

only used his own hands he could not push around a small creek, let alone a river. The Civil Engineer does not rely on muscle. When he desires to move a mountain or wipe out a few hundred square miles of desert with a dam, he takes his logarithm book and retires to a quiet spot where he fills an acre of brown paper full of figures. At the end of six months he emerges with a tired air and a carload of blueprints and motions to the steam-shovels to come on up and get busy.

The Civil Engineer is not generally known. This is because he cannot often be found on the street corners or in the clubs or in the act of decorating grand opera with a vast white shirt front. He usually lives in the wilderness in hip boots and a last week's shave. After the ordinary man has lived in the wilderness for a few years his mother wouldn't know him. But after an engineer has lived in a wilderness the same length of time its mother wouldn't know it. The Engineer is continually editing and revising nature, rearranging mountains, and making rivers back up and go the other way. He is as restless and unsatisfied with the way things look as the woman who always rearranges the parlor furniture while her husband is away so that he may fall over it when he comes home in the dark and receive a pleasant surprise.

The Civil Engineer has hung railroads on mountain sides, run tunnels under city streets, made oceans shake hands, harnessed up Niagara Falls, made parks out of the western deserts, and has put a reverse gear in the Chicago River. Some day he will begin experimenting with the earth's orbit and we may yet have Christmas at the Fourth of July and a weekly comet service to Mars—who knows? Logarithms and a square jaw working harmoniously can do almost anything.

A Card from One of Our Advertisers.

Nelson Valve Company and Yarnall-Waring Company announce the appointment of Mr. H. J. Moyer as representative

in Chicago, also the opening of their own office in the Hearst Building. A full stock is carried in Chicago.

Creosoted Materials Company, Incorporated.—The Creosoted Wood Block Paving Co., in order to more accurately represent its complete line of business, has changed its name to the Creosoted Materials Company, Incorporated. Mr. R. S. Manley is the president and Mr. D. E. Roach is the secretary-treasurer. They retain their same quarters in the Q. & C. Building. This company is sales agent for the American Creosote Works and also New Orleans and Export representative of the Southern Creosoting Company, Ltd., of Slidell, La.

New Members.—As a partial result of the campaign for new members the following names have been added to the roll of the Society:

Resident Members.

A. F. Barelay, 5670 Rosemary Place, City.
James D. Beck, 2331 Constance street, City.
Lezin A. Beemel, 1510 Arabella street, City.
John Walter Fairlie, 6319 Laurel street, City.
James McC. Fourmy, 2218 Prytania street, City.
Frederic D. King, Jr., 1418 Seventh street, City.
James C. Moore, 2612 Marengo street, City.
Oscar Riess, 1423 Milan street, City.
Gilbert D. Von Phul, 322 Hibernia Building, City.
Charles S. Williamson, Jr., Tulane University, City.

Non-Resident Member.

John deM. Crawford, 12th floor Q. & C. Building, City.
Transfer from Non-Res. Assoc. Member to Non-Res. Member.
Samuel Wallace Elbertson, Crowley, La.

Resident Associate Members.

George J. Glover, 1022 Whitney Bank Building, City.
W. E. Wakefield, 1709 Baronne street, City.

Resident Junior Member.

William F. Eblen, 7822 Green street, City.

Non-Resident Junior Member.

Carl Schneider, Meraux, La.

Transfer from Student to Resident Junior Member.

Clifford H. Stem, 6933 Poplar Street, City.

Honor for a Tulane Student of Civil Engineering.—For a number of years past the Engineers' Society of Western Pennsylvania has been holding annual competitions in engineering problems. Students from all over the country take part in these competitions. This year the Civil Engineering problem consisted of the design of a steel mill building of given dimensions and for specific purposes. The general specifications for the steel were to be the same as those given in the Carnegie Hand-Book. Two Tulane students of the School of Civil Engineering entered the contest and submitted their designs. One of them, Mr. William B. Monroe, received an honorable mention. Mr. Monroe graduated this past June from the School of Civil Engineering, and he is also a Student Member of this Society.

PAPERS AND DISCUSSIONS

STORM TIDES ALONG THE CENTRAL GULF COAST.

By

CHAS. W. OKEY, .

Read before the Society, September 11, 1916.

It is a matter of common knowledge that heavy winds which blow for any considerable length of time directly on or off shore cause an unusual variation in the stage of the water. This effect is not limited to any particular climate or character of coast line. Usually however the highest tides are caused where the coast borders on wide areas of comparatively shallow water and naturally the greatest effects are noticed where the coasts are low and flat for considerable distances inland. Coasts in such latitudes where tropical hurricanes occur experience the greatest tides due to wind.

The Central Coast of the Gulf of Mexico is for the most part low and flat and is bordered by wide areas of shallow water. Tropical hurricanes travel northward across the Gulf causing winds of great velocity on the coast. Therefore conditions are favorable to high storm tides and every hurricane which strikes the coast causes tides far above the daily variation. The U. S. Weather Bureau has made careful and complete studies of all such storms in recent years and issues warnings in regard to their probable intensity and path. These warnings are of immense value to the shipping interests as vessels can either avoid the track of the storm or stay in protected harbors until danger is past. The warnings are also of value to residents of exposed places who may make preparations to weather the effects of wind and tide or move to places of safety. Manifestly residents of the coast cannot avoid the effects of storms as easily as can the ships. Their proper course is to build structures that will withstand the effect of storm tides. To do this they must profit by observing the effects of such storms and collecting data as to the height of

storm tides. As different storms affect the same parts of the coast in varying degree the study should cover as many storms and as wide a range of coast as possible. As the coast line to be covered was so extensive and as the reclamation and drainage of a large share of the coast marshes depend on their adequate protection from tidal overflow the task of gathering data in regard to storm tides was undertaken by the Department of Agriculture. The first work was done immediately after the storm of September 20, 1909, by A. M. Shaw then a drainage engineer in the employ of the Department and continued by the writer in the early part of 1910. After the great storms of August 16-17 and September 29, 1915, the writer was authorized by the Office of Public Roads and Rural Engineering, Drainage Investigations, Department of Agriculture to collect all such data as possible about the storms and their effects.

Preliminary to field investigations calls were made on all the engineering offices in and near New Orleans for such data as they had collected. Government and State Engineers, railway and private engineers were all very cordial in their coöperation and a large amount of accurate data was obtained from them. Opportunity in here taken to acknowledge this coöperation which did much to increase the accuracy and extent of the work.

Visits were made to a large number of points along the coast from Biloxi, Mississippi, to Palacios, Texas. High-water marks were observed and referenced in to the nearest bench mark or to mean tide level as given by local observers. At times marks left by the water inside buildings were available at other times the testimony of eyewitnesses was depended upon. In certain localities accurate marks were not obtainable. In general it was found that from Biloxi, Miss. to near the mouth of Bayou Lafourche the tides caused by the storm of September 29 exceeded all others recorded. In the upper portion of Terrebonne and Timbalier Bays the records of the storm of 1909 were not equalled. From this point westward the tides caused by the storm of August 16-17, 1915, with few exceptions exceeded all others recorded. A

table has been prepared showing the highest storm tide recorded at the various points accompanied by other data as to direction of wind exact date of highest water, direction of flow of tidal water, length of time water was above mean Gulf two feet, and date and height of previous highest water. A second table shows somewhat similar data for practically all the light stations from Pascagoula, Mississippi, to Brownsville, Texas. This data was collected through the kindness of the Lighthouse service by the inspector of the eighth district, Mr. Dory of New Orleans. Data from both the storms of 1915 were requested and furnished. The highwater marks have been platted on the accompanying map, along with the probable track and progress of the storm centres. A study of the tables and maps together will make the material in the tables more valuable.¹

In making the inspections of the various points on the coast all information possible was collected about the nature of the rise and fall of the tides, their effects on structures, embankments, beaches, etc. It is believed that it will add to the value of the report to give these details in full. For a considerable part of such information reliance was placed in the testimony of eyewitnesses and while it is conceded that during such storms considerable excitement prevails, an effort was made to accept only such testimony as had the appearance of being correct and was confirmed from other sources. For convenience the information will be given for points as they occur along the coast from east to west. *All Elevations above Mean Gulf Level.*

Biloxi, Miss. 9.00 feet. The height of the water, shown by marks, in the tool storage house of the Dunbar and Dukate Canning Factory was measured by the writer. The factory is located to the east end of the city of Biloxi and immediately north of Deer Island. The highest water occurred during the night of September 29. The wind blew from the northeast during the day and went to the south during the early part of the night and at that time blew the hardest. Due to the

1. For a detailed description of the storm of 1909 see U. S. Dept. Agr. Monthly Weather Review, 1909, p. 623; for storm of August 16-17, 1915, see same publication for August, 1915; and for storm of September 29, see same for September, 1915.

DATA FROM LIGHTHOUSES

Approx Hight of Storm Tides along the Gulf Coast between Biloxi, Miss. and Corpus Christi, Texas.

State, County, or Parish	Name of Station	STORM OF AUGUST 16-17, '15.			STORM OF SEPTEMBER 29-30, 1915.		
		Hight above Mean Gulf	Day	Hour	Hight above Mean Gulf	Day	Hour
Miss., Harrison Co.	Biloxi I.t. Sta.	—	—	—	11.5	9-29	11:30 p. m.
Miss., Harrison Co.	Biloxi Harbor I.t.s.	—	—	—	13.0	—	—
Miss., Harrison Co.	Horn Island, I. S.	3.5	8-16	8 a. m.	6.0	9-29	9 p. m.
Harrison Co.	Ship Island, I. S.	4.0	8-17	6 a. m.	7.3	9-29	6:30 p. m.
Miss., Pascagoula	Round Island, I. S.	—	—	—	6.5	9-29	9:15 p. m.
La., St. Bernard	Chandeleur I. S., La.	3.2	8-16,17	5 p. m.-1 a. m.	6.2	9-29	5 p. m.-11 p. m.
Miss., Harrison Co.	Gulfport Chan. I.t.s.	—	—	—	10.9	9-30	12 m.
Miss., Harrison Co.	Merrill Shell Banks, I. S.	5.0	8-17	5 p. m.	7.0	9-30	11 p. m.
Miss., Hancock	Lake Borgne, I. S.	—	Ordinary High Tide			11-12	—
Miss., Pascagoula	Pascagoula R. Entr. I.t.s.	4.0	8-16	11:30 p. m.	6.5	9-29	9:30 p. m.
La., Orleans	Pointe Aux Herbes, I. S.	2.5	8-17	2 a. m.	—	—	—
La., Orleans	West Rigolets, I. S.	3.2	8-17	6 a. m.	7.2	9-30	2 a. m.
La., Orleans	Bayou St. John, I. S.	3.0	8-16	7:45 a. m.	4.0	9-29	5 p. m.
La., Plaquemines	Pass A Loutre, I. S.	2.0	8-16	6 a. m.	3.5	9-29	10:30 a. m.
La., Plaquemines	So. Pass Rg. Br., I. S.	3.0	—	11 p. m.	3.6	—	9 a. m.
La., Plaquemines	Southwest Pass, I. S.	—	—	—	5.8	—	—
La., Plaquemines	Head of the Passes, I. S.	—	—	—	7.3	9-29	Bet. 2 and 3 p. m.
La., Jefferson	Barataria Bay, I. S.	2.0	8-16	9 p. m.	9.0	9-29	9 a. m.
La., LaFourche	Timbalier, I. S.	5.4	8-16	2 p. m.	8.3	9-29	2 p. m.
La., Terrebonne	Ship Shoal, I. S.	7.7	8-16	5 p. m.	4.5	9-29	10 a. m.
La., Terrebonne	Oyster Bayou, I. S.	9.0	8-17	1:30 p. m.	1.5	9-28	5 p. m.
La., St. Mary	Southwest Reef, I. S.	9.0	8-17	3 p. m.	Gale from N. E. to N. W. all day		
					Very low tide all day and night		
					No storm		
La., Cameron	Calcasieu Rge., I. S.	11.0	8-16	11:30 p. m.	3.0	9-30	9 a. m.
La., Cameron	Sabine Bank, I. S.	10.5	8-16	11:30 p. m.	Tide was below normal		
La., Cameron	Sabine Pass, I. S.	10.8	8-17	1 a. m.	2.5	—	—
Texas, Aransas Co.	Aransas Pass, I. S.	4.5	8-17	7 a. m.	No rise in tide		
Texas, Calhoun Co.	Matagorda, I. S.	4.3	8-17	7 a. m.	4.3	9-29	4 p. m.
Texas, Brazoria Co.	Brazos Santiago, I. S.	5.0	8-17	8 a. m.			

Approximate Height of Storm Tides at Towns Along the Gulf Coast.

PARISH, COUNTY OR STATE	NEAREST TOWN	Height Above Mean Gulf	DATE			Direction Max Wind	Direction Water Came	Approx. Period Water Was Above 2 Ft. Mean Gulf Datum	Previous Highest Water	
			Year	Day	Hour				Height Above Mean Gulf	Date Year Mo. Day
Mississippi	Biloxi	9.9	1915	9-30	1 a. m.	S	S	One Day	9.0	1893
Mississippi	Gulfport	9.6	1915	9-29	m.	S	S	One Day	8.5	1893
Mississippi	Pass Christian	10.9	1915	9-29	11 p. m.	S	S	One Day	—	1909 9-20
Mississippi	Bay St. Louis	11.8	1915	9-29	10 p. m.	S	S	One Day	6.0	1909 9-20
Mississippi	Lake Shore	10.8	1915	9-29				One Day	—	1909 9-20
Mississippi	Bayou Caddy	10.6	1915	9-29	10 p. m.	S W	S W	One Day	6.6	1909 9-20
Mississippi	Baldwin Lodge	10.6	1915	9-29				One Day	—	1909 9-20
Orleans	Rigolets	9.8	1915	9-29	7 p. m.	E	S E	One Day	6.0	1909 9-20
Orleans	Lake Catherine	9.6	1915	9-29	7 p. m.	E	S E	One Day	—	1909 9-20
Orleans	Chef Menteur	10.1	1915	9-29	7 p. m.	E	S E	One Day	—	1909 9-20
Orleans	Michoud	11.0	1915	9-29		E	S E	One Day	—	1909 9-20
Orleans	Lee	7.0	1915	9-29	7 p. m.	E	S E	Two Days	—	1909 9-20
Orleans	Little Woods	5.6	1915	9-30	6 a. m.	E	S E	Ten Days	—	1909 9-20
Orleans	Citrus	6.2	1915	9-30	6 a. m.	E	N W	Four Days	—	1909 9-20
Orleans	West End	6.1	1915	9-30	6 a. m.	E	N W		6.2	1909 9-20
Jefferson	Kenner	6.0	1915	9-29		E	N E		—	1909 9-20
St. Charles	LaBranche	12.0	1915	9-29	7 p. m.	N E	N E	Two Days	—	1909 9-20
St. John	Frenier	13.0	1915	9-29	7 p. m.	N E	N E	Two Days	—	1909 9-20
St. John	Napton	13.0	1915	9-29	7 p. m.	N E	N E	Two Days	—	1909 9-20
St. John	Ruddock	9.0	1915	9-29	7 p. m.	N E	E	Two Days	8	1909 9-20
St. John	Manchac	5.0	1915	9-30	4 p. m.	N E	E	Three Days	4	1909 9-20
St. John	Manchac I.t.	6.0	1915	9-29	8 p. m.	N	N E	Two Days	4.5	1909 9-20
St. Bernard	Yscloskey	11.6	1915	9-29	6 p. m.	S E	S E	Four Days	5	1009 9-20
St. Bernard	Hopedale	9.0	1915	9-29	6 p. m.	S E	S E	Four Days	6	1909 9-20
St. Bernard	Bayou LaLoutre	10.0	1915	8-29	6 p. m.	S E	S E	Four Days	7.5	1909 9-20
St. Bernard	Shell Beach	8.3	1915	9-29	2 p. m.	S E	N E	One Day	—	1909 9-20
Plaquemines	Caernovan	6.4	1915	9-30	11 a. m.	S E	E	Ten Days	—	1909 9-20
Plaquemines	Phillips	6.6	1915	9-30	2 a. m.	S E	E	Ten Days	4.0	1909 9-20
Plaquemines	Isle de LaCroix		1915	9-29		S E	S E		5.5	1909 9-20
Plaquemines	Pointe a LaHache	11.6	1915	9-29	5 p. m.	S E	E	Two Days	7.5	1909 9-20
Plaquemines	Ft. St. Philip	11.6	1915	9-29		S E	E	Two Days	—	1909 9-20
Plaquemines	Port Eads	3.8	1915	9-29		S E	E	Three Days	3.5	1909 9-20
Plaquemines	Burrwood	5.8	1915	9-29		S S E	S	Three Days	—	1893 9-20
Plaquemines	Venice	7.1	1915	9-29		S S E	S	Three Days	—	1893 9-20
Plaquemines	Buras	7.7	1915	9-29	1 p. m.	S E	S	Three Days	5.0	1893 9-20
Plaquemines	Empire	9.3	1915	9-29		S E	S	Three Days	—	1893 9-20
Jefferson	Grand Isle t.	9.0	1915	9-29	1 p. m.	S E	S E	Two Days	5.5	1909 9-20
Jefferson	Manila Village	8.0	1915	9-29	2 p. m.	S E	S	Three Days	—	1893 9-20
Jefferson	Barataria	3.0	1915	9-29	8 p. m.	S W	S	Two Days	2.5	1909 9-20
LaFourche	Lockport	3.0	1909	9-20		S E	S	Two Days	—	1909 9-20
LaFourche	Cut Off	4.7	1915	9-29	4 p. m.	E	S	Two Days	4.0	1909 9-20
LaFourche	Golden Meadows	5.5	1915	9-29	3 p. m.	E	S E	Two Days	5.0	1909 9-20
LaFourche	Leeville	9.0	1915	9-29			S E	Two Days	8.0	1909 9-20

LaFourche	Sea Breeze	15.0	1909	9-20	10 p. m.	S E	S E	Four Days	1856
LaFourche	Four League Bay †		1915	8-17		S E	S E	Four Days	1856
LaFourche	S. of Montegut	10.0	1909	9-20		S E	S E	Four Days	1856
LaFourche	Montegut	5.0	1909	9-20		S E	S E	Four Days	1856
LaFourche	Bourg	3.0	1909	9-20		S E	S E	Four Days	1856
St. Mary	Louisa	9.5	1915	8-17		S E	S E		
Iberia	Weeks	6.0	1915	8-17		S E	S W		
Iberia	Avery	5.0	1915	8-17		S E	S		
Iberia	Marsh Isle	9.5	1915	8-17		S E	S		
Iberia	S. W. Pass	8.0	1915	8-17		S E	S		
Vermillion	Schooner Bayou Lock	5.0	1915	8-17		S E	S E	Five Days	
Cameron	East End—Grand Chenier	3.5	1915	8-17	6 p. m.	S E	S W	Five Days	
Cameron	Grand Chenier, P. O.	10.0	1915	8-17	1 a. m.	S E	S	Five Days	
Cameron	Mermentau R.	5.0	1915	8-17		S E	S W	Five Days	
Cameron	Creole	5.0	1915	8-17		S E	S	Five Days	
Cameron	Cameron	10.3	1915	8-17	1 a. m.	S E	S	Five Days	
Cameron	Hackberry	6.0	1915	8-17	6 a. m.	S E	S	Five Days	
Cameron	Lake Charles	5.1	1915	8-18	6 a. m.	S E	S	Five Days	
Cameron	Black Bayou	6.0	1915	8-17		S E	S	Five Days	
Cameron	Johnson Bayou	10.0	1915	8-17		S E	S	Five Days	1886
Texas									
Jefferson Co.	Port Arthur	* 6.9	1915	8-17		S E	S	Five Days	
Jefferson Co.	Sabine Lake	7.3	1915	8-17		S E	S	Five Days	
Jefferson Co.	Port Neches	6.7	1915	8-17		S E	S	Five Days	
Jefferson Co.	Sabine Pass	11.2	1915	8-17		S E	S	Three Days	
Chambers	High Island	14.4	1915	8-17		S E	S	Five Days	
Galveston	Roll Over	13.9	1915	8-17		S E	S	Five Days	
Galveston	Port Bolivar	11.5	1915	8-17		S E	S	Five Days	
Chambers	Double Bayou	13.0	1915	8-17		S E	S	Five Days	
Chambers	Anahuac	14.4	1915	8-17		S E	S	Five Days	
Chambers	Wallisville	13.1	1915	8-17		S E	S	Five Days	
Chambers	Morgan Pt.	13.8	1915	8-17		S E	S	Five Days	
Harris	Sylvan Beach	15.1	1915	8-17		S E	S	Five Days	
Harris	Sea Brook	15.0	1915	8-17		S E	S	Five Days	
Harris	San Leon	15.2	1915	8-17		S E	S	Five Days	
Galveston	Texas City	14.0	1915	8-17		S E	S	Five Days	
Galveston	Virginia Point	15.3	1915	8-17		S E	S	Five Days	
Galveston	Galveston	11.7	1915	8-16	11 p. m.	S E	S E	Five Days	
Brazoria	Velasco	8.8	1915	8-17		S E	S E	Five Days	
Brazoria	Freeport	9.8	1915	8-17	1 a. m.	S E	S E	Five Days	
Brazoria	Bryan's Mound	7.0	1915	8-17	1 a. m.	S E	S E	Five Days	
Brazoria	Brazos, I. S.	14.8	1915	8-17	1 a. m.	S E	S E	Five Days	
Brazoria	Surfside	14.2	1915	8-17	1 a. m.	S E	S E	Five Days	
Brazoria	Quintana	13.8	1915	8-17	1 a. m.	S E	S E	Five Days	
Brazoria	Oyster Creek	10.5	1915	8-17	1 a. m.	S E	S E	Five Days	
Brazoria	Matagorda	6.0	1915	8-17	8 a. m.	S W	S W	Three Days	
Matagorda	Palacios	5.0	1915	8-17	8 a. m.	S W	S W	Three Days	

† 1893 was higher than 1909.

‡ 5.0 in 1909.

* Remaining highs are above Mean Low Gulf Level.

protection of Deer Island the damage was not very great at this point. A very heavy current swept past the site of the factory going around the east end of the peninsula into Back Bay.

Mr. J. D. Ferguson observed the height of the water at its highest at 1 a. m. September 30 in Lemeuse Street, and afterwards referred the mark to the Government benchmark, finding a height of 9.9 feet. Mr. Ferguson had also observed the high water of 1893 on Deer Island in the house of Mr. Atkins, finding it to be 9.3 feet and in 1909 September 20 it was 8.1 feet.

The damage to the beach westward from Biloxi was very great. Nearly all of the hard surfaced road and the electric railway road bed were washed out. In some places a prism of earth 100 feet wide and 8 feet in depth was taken out. The slope of the resulting beach which is above ordinary high water is almost exactly and uniformly 20 to 1. The slope of the beach down near ordinary low water is steeper, about 10 or 12 to 1. Where the original beach was covered with a good Bermuda Grass sod and had a slope of about 12 or 15 to 1, it suffered much less and in many places the sod was not broken. The soil of the upper part of the beach which was so badly eroded by the waves is almost pure sand, with just enough clay in it to give it color but no binding power. The soil of the resulting beach is practically pure sand. The waves often left a vertical bank at the top of the storm beach 8 or 10 feet high. Small bulk heads down near the low water were overtopped and rendered useless but were not very badly damaged if they were short. Those which were higher and not back-filled were demolished. It is reported that the storms of 1893, 1906 and 1909 tore out some of the beach but as the storms did not last so long the damage was less.

Practically all structures on the beach were demolished. Only the piling remain and they only in part. Most of the structures were of flimsy construction and built at such a height that the floor was at or a little above mean storm tide height. The water was soon full of wreckage which aided in battering to pieces the stronger structures.

Gulfport, Miss.—The water reached its highest at midnight September 29 in the storeroom of Mr. Thomas Fabre's shipyard at elevation 11.0. On the buildings out on the dock of the Gulf and Ship Island Railway, about a half a mile from the main land the height of the water was measured from a mark on the inside of a house occupied during the storm and reached 9.6. The main part of the railway dock is a fill of earth about 250 feet wide and extending out at right angles to the shore line. Along the western side wooden platforms and walls allow the ships to tie up close alongside. As this wooden construction was very substantial it was not badly damaged during the storm. However the water covered the entire dock and washed out some of the earth filling.

The beach near Gulfport was damaged almost the entire length except where it was very sloping and covered with Bermuda sod. All bathing piers and houses were demolished.

Pass Christian.—The water was measured by the writer in the factory of the Dunbar & Dukate Canning Co. by means of a gasoline drum that was wedged in the foot of a water tower. While the wave wash at that point was not heavy the measurement may be in error a foot. The height reached at about 11 p. m. was shown by this measurement to be 10.9 feet. The wind followed about the same course as at Biloxi going from N.E. by way of S.E. to S.W. about 11 p. m. when the highest water occurred.

All structures on the beach were destroyed and a considerable portion of the canning factory was torn out, but as the factory is built on a huge pile of oyster shells it was well protected. The beach itself suffered badly but there were considerable stretches which had a very flat slope well sodded and these stood the storm very well.

Bay St. Louis.—The height of the water was measured at this point by the engineers of the L. & N. Railway in a house in the back portion of the bay. The mark is undoubtedly accurate and was 11.8 feet. The highest water was experienced during the early part of the night of September 29. It came when the wind was blowing from the S.E.

All structures on the beach were demolished except a bath house just south of the L. & N. Railway trestle. This house was very well built and was about 16 or 18 feet above mean tide level, thus escaping the heaviest wave action. A sea wall of reinforced concrete ran from a point perhaps 500 or 600 feet north of the railway trestle to about 1000 feet south of it. Along the northern and central portion of the wall it faces almost directly east but towards the southern end it curves to the southwest. The top of the wall was about elevation 10.0. It was perhaps two feet thick at the base and a foot at the top. The outside face had a slight batter inward. At intervals of 10-15 feet the wall was anchored to the bank in the rear with an inch square iron rod grouted into the wall and fastened to a deadman buried in the bank. In about half the cases the wall was further anchored by an inch galvanized steel cable fastened to a second deadman but bolted to the square iron rod close to the concrete. All but the southern end of the wall was backfilled with sand. The portion not backfilled was demolished. The action of the waves was doubtless aided by considerable heavy floating timber and piling, which acted as battering rams. After the wall was demolished the bank behind was eroded back a distance of nearly a hundred feet in places to a depth of 8 to 12 feet. The portion of the wall which was backfilled did not suffer greatly. The waves broke over it and filled in the space behind with water. The resulting pressure which become very heavy when the tide rapidly receded forced the wall out from the bank in many places. Where the single iron rod anchor was used the deadman was moved in the bank several inches. Where the iron rod was reinforced with the steel cable the rod was often broken loose from the concrete. The rod did not extend through the wall, but depended on the bond of the concrete for its connection.

Westward along the beach from Bay St. Louis the erosion was very extensive and was probably greater than in the vicinity of any of the towns to the east. The wind velocity was probably greater than points farther east. All beach structures were demolished and the shell road was taken

away almost entirely. Large trees were undermined and washed out completely. The damage often extended well into the grounds of residences.

Coleman Avenue.—This point is about three miles west of Bay St. Louis. The height of the water was measured at this point in the residence of Mr. D. H. Coleman who observed the height of the water. It was 11.8 feet and was at its highest in the early part of the night. The wind at that time was almost directly south. The highest water previous to this one was in 1909 and lacked about 3 feet from being as high.

Lakeshore, Miss.—The height of the water at this point was measured by the engineers of the L. & N. Railway in the station house and was 10.85 feet.

The track of the L. & N. Railway was washed out by the water coming in a low neck of land known as Jackson Marsh just north of Ansley station. From near Lakeshore down to Pearl River the track was damaged only at intervals.

Bayou Caddy, Miss.—The height of the water was measured in the canning factory of Mr. Jullianne, which lies on Bayou Caddy about a mile south of Lakeshore. The water was highest about 10 p. m when it reached 10.60 feet. The wind came around from the N.E. by way of S.E. to the S.W. about 10 p. m. when the heaviest wind occurred.

Baldwin Lodge, Miss.—The water was measured at this point by engineers of the L. & N. Railway from marks on buildings and was 10.60 feet.

From the Pearl River bridge to Rigolets the track of the railway was badly damaged. Almost all the ballast was taken out and a considerable portion of the earthen embankment. At Dunbar, La., practically all the houses were demolished, as most of them were of very light construction. A few houses which were heavier and were up on supports above the heaviest of the waves were still standing.

The railway bridge over the Rigolets was badly damaged. Nine hundred fifty feet of trestle and sixteen plate girder spans north of the draw span were lost and one plate girder span south of the draw. Between the Rigolets bridge and Chef Menteur the embankment of the railway was practically

all gone; in places it was eroded below the original level of the marsh but usually was left from 2 to 4 feet above. The grade was originally about 7 feet above Mean Gulf Level. This embankment was protected on both sides by a heavy layer of especially selected tenacious clay and carried a track with 90-pound rails anchored by means of cables to Crouse & Hinds fluke anchors driven into the ground to the southeast of the embankment. While these anchors prevented the track from being carried away the water carried out the ballast and soft material from the centre of the track and the clay was thus undermined and also carried out.

Rigolets, La.—The height of the water was measured at this point by the engineers of the railway from a mark in the inside of the closed station house. It reached its highest, 9.8 feet about 7 p. m. The water began to come in rapidly from the southeast at this point at about 4 p. m. at which time it covered the marsh grass; it then raised very rapidly until 7 p. m. The wind was in the N.E. all day and was hardest about 6 p. m. when it was in the east. The wind changed to the S.E. about 7 p. m. and gradually shifted to the S.W. by midnight. The water began to fall shortly after it reached its highest stage and fell quite rapidly so that by daylight of the 30th it was down off the track and the grass in the marsh showed. There was a heavy current through the Rigolets as the water rose and fell. As the water rose and began to run over the track there was a difference of water levels between the east and west side of the tracks of three feet.

Lake Catherine, La.—The height of the water at this point was measured by the railway engineers and was shown by a mark elevation of 9.6 feet left by the water in the inside of the closed tool house. The section foreman, Mr. Green, stated that the water came in very rapidly after it rose the first couple of feet over the marsh. The openings in the track were not sufficient to allow the water to rise as fast on one side as the other and after the water began to run over the track with a fall of at least three feet it was two or three hours before it equalized itself. It was this running over of the water that did the great damage to the track and embankment. The part

of the embankment near the ground was not much damaged and gave no evidence of wave wash. The waves did not have much height until the water was well up over the track. Previous to that time the waves were broken by the heavy growth of grass. Where there was a considerable stretch of heavy grass to the east of the track the wave action was not so heavy. The water was highest at Lake Catherine at about 7 p. m. and was still over the track at midnight when it went out rapidly with the change of the wind and by daylight the marsh grass was in sight. The wind was in the N.E. during the day and went to east at its worst about 7 p. m. About 8 p. m. it changed to S.E. and turned to the south and S.W. quite rapidly at midnight.

Between Rigolets, Lake Catherine and Chef Menteur the embankment was very badly washed. In places the material was carried in a great windrow to the northwest for a distance of 100 to 200 feet. The embankment seemed to have failed like a levee in a series of crevasses as the depth of erosion was not uniform. The current through these crevasses was also very heavy when the water began to go down and material was washed to the southeast. In general the clay protection on the southeast side of the embankment suffered less than it did on the other side. The incoming water naturally washed the west side the worst and the outgoing water did not have such a great velocity and went through the lowest places.

Chef Menteur, La.—The height of the water was measured at this point by the railway engineers from a mark set by the bridge tender on a piling under his house. The bridge tender observed the water at 10 p. m. when it had started to fall a little. It was his judgment that the water was about the same stage from 7 p. m. to 10 p. m. and was 10.1 feet. The water came in very rapidly after 4 p. m. when it covered the marsh grass. The water went through the opening at Chef Menteur with a heavy velocity both as it came in and went out. The fall through the opening was three feet during the rapid part of the rise and after the water began to run over the track with a fall of three feet it was about two hours before it was

the same height on both sides. The wind followed the same course at Chef Menteur as at the other nearby points.

All lightly constructed buildings that were not well above the water level during the storm were demolished or floated a considerable distance. Those of heavier construction which were not above the water were usually floated off the supports and dropped in the marsh. Five steel girder spans were lost from the bridge at Chef Menteur. From near Rigolets to west of Chef Menteur all telegraph and telephone lines were down. This was the first time that the lines of the American Telegraph and Telephone Company have gone down completely along this stretch.

Fort Macomb.—This fort is located about 500 feet northwest of the railway and about the same distance from the Chef. While the interior of the structure is of brick the outer works are of earth; separated from the interior by a moat. The outer works were apparently built with material taken from the moat. This was the usual sticky alluvial mud of the marshes. The side slopes are 4 or 5 to 1. The height of the embankment is about 17 or 18 feet. The slopes are even and unbroken entirely around the fort. They appear not to have been damaged by this or any other of the storms that have occurred since the fort was built. In a few places the sod was broken to a depth of a few inches, but only in small spots. The slopes were covered with grass and considerable coarse wild cane. The slopes were partly protected from wave wash before the water overtopped the railway embankment but afterwards they must have received the full force of the waves. Considerable timber littered the slopes showing that the sod had resisted the pounding of such debris.

From a point 2 miles southwest of Chef Menteur on to New Orleans there was very little damage to the railway except that considerable ballast was washed out. A large amount of the turf from the top of the marsh soil was torn loose by the wave action in the marsh and deposited on top of the rails. This material was often piled up 3 or 4 feet thick.

The sides of the embankment were not affected at all by wave wash as they were protected by a heavy growth of grass and cane.

About a third of a mile east of Michaud station the railway enters a belt of cypress timber coming in from the north-east. This strip of cypress borders the ridge on which is the road from New Orleans to Chef Menteur. All along the south side of this strip there is a great quantity of debris. This was mostly the turf from the marsh mixed with timbers of all sorts and grass. The debris was often 3 or 4 feet thick and covered a strip from 100 to 300 feet wide. Evidently there was a sufficient quantity of it to offer a great deal of resistance to the flow of the tide water through the cypress timber to the open prairie to the northwest near Lake Pontchartrain. At Michaud station which is at the junction of the railway and the road to Chef Menteur the height of the water was measured by the railway engineers from a mark inside a building. It was eleven feet.

There was evidently a heavy current westward from Michaud towards Lee station along the right of way of the railway. This was the only cleared space through which the water could go unobstructed across the Bayou Sauvage Ridge. Only a small amount of gravel ballast was washed out of the embankment from this point westward.

Lee Station.—The section foreman at this point stated that the water did not begin to come in along the south side of the embankment until late in the afternoon. At about 7 p. m. it was high enough on the south side to begin to run over the rails. It then ran over the rails for a little more than half an hour at a depth of not more than 8 inches. This makes the elevation of the water seven feet on the south side of the track. The water on the north side of the track was never more than about one foot deep on the surface. The wind was from the northeast at this point through most of the day until about 7 p. m. when it checked in velocity and changed very rapidly to the west. This checked the flow of the water over the track and soon stopped it entirely. The foreman also stated that when the water was two feet over the track at

Michaud there was no water in sight at Lee, and that some laborers came along the track from the direction of Michaud ahead of the rising water.

Little Woods, La.—At this point the elevation of the water on a gauge was read by the engineer on the pumping station of the Lake Shore Land Co. It reached its highest elevation at 6 a. m. of the morning of the 30th—5.6 feet. The water came in slowly from the east across the heavy growth of prairie grass. The wave action was never heavy. The fall of the water was also very slow due to the resistance offered by the grass and the subsequent heavy rainfall.

Pontchartrain Groves.—The highest water was observed at this point in the discharge basin of the pumping plant by the engineer. This discharge basin is the same level as Lake Pontchartrain. It reached an elevation of 6.2 feet at 6 a. m. of September 30. At noon of the 29th the water had raised 4.4 feet and at noon of October 1 it was 4.1 feet above mean gulf level. The water in Lake Pontchartrain fell more rapidly than the water in the prairie to the east of Little Woods and by noon of the 5th was down within two feet of mean gulf level. Evidently the highest water at this point was caused by the high water from the west end of Lake Pontchartrain going out again to the Gulf; for by the morning of the 30th the wind had subsided and had been blowing off shore the most of the night.

West End.—The water at this point reached an elevation of 6.1 late in the afternoon of the 29th and held the elevation until the next day. The elevation of the water in all the navigation and outfall canals from pumping stations of the city was about the same. The water in the Lake went down more rapidly than did the water in the cypress swamp in the eastern end of the parish and immediately outside the city limits. (The above tide heights were the highest reached and were a few inches higher than those of September 19-20, 1909.)

Mississippi River at Canal Street.—On September 28, 1915, the stage of the water in the river was 12.3 on the Canal Street gauge. At 8 a. m. of the 29th it was 13.9 and at 5 p. m. of the same day it has risen to 16.0. Shortly afterwards the

ferry house blew down and wrecked the gauge. It was the opinion of Col. Sidney F. Lewis that the water reached an elevation 17 or even higher during the night. Consequently the damage to levees and other structures along the river was very great. In September, 1909, the water rose in the river from a reading of 4.6 on the Canal Street gauge to 11.0 feet.

Kenner, La.—The water was measured at the pumping station of the drainage district about two miles northwest of the railway station. It reached a height of 6 feet. Between this point and Lake Pontchartrain there is a considerable growth of timber which prevented the water from getting as high as it did on the lake shore.

From a point a few miles above Kenner on the I. C. Railway damage was sustained on the railway embankment. The ballast was washed from the top of the embankment by the water coming from the east out of Lake Pontchartrain. Farther up towards La Branche the entire embankment was washed out quite deeply in places. The material from the embankment was carried from 100 to 300 feet to the west and the track was carried a considerable distance from the original location. Northward from La Branche the embankment was almost completely destroyed up as far as the station of Napton and fairly heavy damage was sustained to a point above Ruddock.

LaBranche.—The height of the water was observed at this point by Mr. M. P. Roundtree on the supports of the railway water tank on which he had taken refuge from the water. As the tank was protected by a screen of trees there was no very heavy wave action and the mark is accurate. It was 12.0 above mean gulf level. The lake rose at this point about 4 feet early in the morning of the 29th, but after daylight it fell about a foot. With the increasing wind it raised again during the morning and by noon was about 6 feet above normal. Between 1 and 6 p. m. it rose very rapidly and reached its highest at 7 p. m. The rise shortly after noon was very rapid. The water flowing through the railway bridge over Bayou LaBranche had a fall of at least 5 feet at this time. When the water began to go over the track in the

afternoon there was a difference in elevation of the water on the east and west sides of about 5 feet. As in the case of the embankment of the L. & N. Railway the rapid destruction of the I. C. Railway embankment was caused by the water pouring over it. The wind blew from the east or a little north of east to northeast to north to northwest. It blew the hardest when making this change of direction. By 10 p. m. the wind was in the west. With the change in direction of the wind the flow of the water from the lake was soon checked and the water began to run back into the lake. By 2 a. m. of the 30th it was down within 2 or 3 feet of normal.

Bayou LaBranche Drainage District.—This district lies on the southeast side of Bayou LaBranche between the railway embankment and the lake. The levee enclosing the district starts on the south side of the bayou at the railway embankment runs down the bayou to the lake front, then parallels the lake at distance inland of about from 200 to 300 feet for about a mile, then turns to the southwest and joins the railway embankment about a mile south of LaBranche. For the most part the levees are 4 or 5 feet above mean lake level. Along the bayou and the lake front the levee has side slopes of about 2 to 1 and a top width of 3 or 4 feet. The berm between the levee and the lake was grown up with brush from 5 to 7 feet in height. The levee was built with material taken from a canal on the inside of the district leaving a berm of about 15 feet between the levee and the canal. The canal was about 5 feet deep and 30 feet wide. A good portion of the levee along the bayou was smoothed off and covered with a fairly good Bermuda sod. Only a portion of the levee along the lake was smoothed off and sodded.

Wave action did no damage to this levee as all damage was caused by overtopping. The outside slope was smooth and unbroken. Where the levee was smooth and the Bermuda sod good practically no damage occurred. Along the top of the levee was a deeply worn cattle trail and the washing seemed to start in this trail. The material in the levee for the most part is a sandy alluvial clay which is not very sticky or resistant to washing. It is not the typical Sharkey clay of the

swamps. The washing was limited almost entirely to the inside slope and the nearest portion of the top. In only a very few cases was the berm between the levee and the inside canal damaged. The average depth of washing on the places damaged was less than a foot. In two places the levee was torn out completely for a length of about 50 feet each. At these points small bayous had been crossed and the levee was low and soft. From the point where the levee leaves the lake and goes towards the railway the material was comparatively new and rough as the dredge had left it. Bermuda sod had not been started. Considerable washing along this line had occurred but only one complete washout was experienced where a dredge had crossed the site of the levee leaving it weakened and low. Where the levee joined the railway the water flowed out of the district into the swamp beyond. The district must have filled with water sooner than did the swamp to the southeast. As the interior of the district had less growth on the surface than did the undrained swamp it offered less resistance to the incoming water than did the swamp.

The water was stationary in level for only a short time at LaBranche. Soon after the water stopped running in it started to run out again. It is the opinion of Mr. Roundtree that a short distance to the westward into the cypress timber the water did not reach a level as high as it did on the lake front. The water did not have time to fill up the country to the westward. Some cattle owned by Mr. Roundtree went back into the cypress swamp and were not drowned.

From LaBranche to the northward the embankment of the railway was washed out completely in many places. Nearly all the trestles were jerked loose from the piling and carried back into the cypress swamp. All houses along this stretch were demolished. Most of the houses were reduced to separate boards by the battering of the waves against the trees to the west of the railway. The current to the west with the rising water and to the east with the falling water was very strong as the ballast from the embankment was washed in both directions.

Frenier.—The height of the water was measured at this point by marks left by the water in a string of refrigerator cars on a siding and from the testimony of eyewitnesses. It was between 12.5 and 13.0 above mean gulf level. The water covered the ground at this point before daylight of the 29th, overtopping the railway track at 2 p. m. and reached its highest about 7 p. m. While there was a good current over the track at this point the proximity to two large culverts and the fact that there was a heavy growth of timber to the west of the railway caused the water to rise very rapidly on the west side of the track. There was very little wave wash back in the timber 200 to 300 feet from the main track and a number of the residents were saved from drowning by floating back into the timber in boats, and on wreckage. The wind was in the east all day and it went to the northwest by 8 p. m. and by about 10 p. m. was from the west. It blew very hard from the northwest. Trees which had stood the easterly wind were torn down or broken off when the wind went to the north and northwest. With the change of the wind the water stopped rising and then started to fall very soon. By midnight it was down off the track and by daylight the ground to the east of the railway was showing. The current of the receding water was quite strong and carried considerable wreckage with it.

Napton.—The water at this point was measured in a house which was occupied during the storm and was not torn down by the force of the waves because it was supported on fairly heavy piling about 9 feet above the ground. The water was approximately 13 feet above mean gulf level. Nearly all structures were demolished at this station. The railway trestles consisted of the usual pile bents and caps fastened on with drift bolts and iron straps spiked on the sides, with stringers and a tight deck covered with about two feet of ballast. The stringers and deck were also spiked to the caps. In many cases the decks and stringers of these trestles were jerked from the caps, and in some cases the caps were taken off with the upper part, and carried over into the cypress swamp to the west.

Ruddock.—The height of the water was measured at this station in the house of the section foreman. The mark was very plain and was 9 feet above mean gulf level. The water was the highest during the early part of the night.

Manchac.—The water was observed at this station by the agent of the railway company. It was 5 feet above mean gulf level. The water came through Pass Manchac from Lake Pontchartrain all day of the 29th and until 4 p. m. of the 30th. The highest water occurred when the wind, which had been in the N.E. all day, changed about 10 p. m. to the N.W. and W.

Pass Manchac Light House.—The water was observed at this light station by the keeper of the light on his gallery floor in the lee of the storm. It reached its highest about 7 p. m. and was at elevation 6 feet. The wind blew from the northwest most of the day and started to change to the north about 5 p. m. It blew the hardest from the north about 5 p. m. The wind was in the west by 10 p. m.

Ycloskey.—The height of the water was measured at this point by a mark in the store of Mr. Nick Fernandez. The mark is undoubtedly correct, and shows the water to have been 11.6 feet. The highest water occurred about 6 p. m. of the 29th. The wind was then blowing from the southeast and the water came from that direction. Earlier in the day the wind was from the northeast and east. It was the opinion of Mr. Fernandez that the water was about the same height at Reggio and at the island south of Reggio. (Isle de la Croix.)

Couturie Residence.—This house was located about a mile west of the Junction of Bayou La Loutre and Solis Lagoon. The height of the water was observed on a tree to which Mr. Couturie had his boat tied during the storm. The mark is accurate, and was 9 feet above mean gulf level. The water was the highest about 6 p. m. and came from the southeast with the wind from that direction. This is the highest water ever recorded at this point. The houses which stood the tide caused by the storm of September 20, 1909, were taken away in 1915. This family has inhabited this locality for 100 years and there is no story of a greater tide height. The water

during this storm came in very rapidly after 3 p. m. The seas were heavy and broke in the open at least 3 feet higher than the mean tide as observed in the timber by Mr. Couturie.

Bayou Terre aux Boeuf Drainage District, Sub-District C.—The height of the water in this district was observed from marks at various places on the levees, in the storage house near the site of the pumping station, and from driftwood on top the levees. The marks are not considered accurate, but averaged about 9.5 feet above mean gulf level.

As will be seen by an inspection of the map this district lies in a bend of Bayou La Loutre. A levee was built along the south side of the bayou by material taken by dredge from the bottom of the bayou. The land immediately along the bayou is perhaps 2 feet above mean low gulf and is very solid material, quite as firm and impervious as any along the Mississippi River. The levee built from this material was from 8 to 9 feet above mean gulf and had a top width of from 2 to 4 feet and side slopes about 2 to 1. The levee was rough as the material dropped by the dredge had not been smoothed down any. The grass had started to grow on the levee, but had not formed a firm sod on a very large part of it. The levee across the south side of the district went directly across the prairie and encountered softer soils. Here the levee was only from 2 to 4 feet high.

In general the levee was not badly eroded. As the water came in from the southeast the low levee on the south side was soon covered by water and protected. Along the western and northern sides the damage was the greatest. While the water on the east side was fully as high as at any other point and the wave wash was just as heavy the levee was damaged very little. The water probably came up about as fast on the inside of the levee as on the outside along this east side so there was no difference of level and no running over.

The levee on the west and north sides was damaged by the water pouring over it. Where it was washed the material was usually deposited in the grass on the berm on the north and west sides. No large amount of wave wash was observed on the east and south sides of the levee. Several places were

washed down a little below the original level of the land for a distance of 30 to 40 feet. In these larger places the material was carried out across the berm into the bayou. The average amount of wash on the levee was very small, and the wash was limited to the places which must have been the lowest before the storm occurred. On all the higher places the grass was still growing undisturbed. The water evidently came in from the southeast into the interior of this district and was pocketed in the north end. It then rose more rapidly than the water to the northwest of the district which could not raise as fast due to the levees. When it finally overtopped the levees the difference in water level must have been considerable. However, the water levels must have been equalized soon afterwards or greater damage to the levee would have occurred. Where the levee was smooth and well sodded the water ran over it without washing appreciably.

Shell Beach on Lake Borgne.—The height of the tide at this point was measured from a mark given by the resident of a substantial house which was occupied by him during the storm. The water came in from the northeast during the day with the wind from that direction and reached a height of 8.3 feet above mean gulf level between 1 and 3 p. m. of the 29th. As soon as the wind went to the east and southeast the water subsided and at 6 p. m. when the water was at its highest at Ycloskey about 2 miles to the southwest of Shell Beach, the water had fallen about 3 feet. At this time there was a heavy current coming from the direction of Ycloskey. By the morning of the 30th the tide was nearly normal at Shell Beach although the water was still high at Ycloskey and there was still a heavy current coming from that direction.

Caernovan.—The mark at this point is accurate and reliable. It was observed and marked by Mr. Robert Serpas on the foundation of his residence. On the same building is a benchmark of the Louisiana State Board of Engineers. The water reached its highest level at 11 a. m. of the 30th. This late date was due to the fact that the water came in slowly through the levees of the drainage district to the rear. The elevation of the water was 6.4 feet.

Phillips Land Co. Pumping Plant.—The height of the water was measured at this point from marks in the inside of the pumping station. The water was quiet inside the building according to the testimony of eyewitnesses. It reached its highest about 1 a. m. of September 30th at elevation 6.6 feet. The water raised rather slowly at this district during the earlier stages of the storm. At 6 p. m. of the 29th it had raised only 3.5 feet, but as the wind veered to the east and then to the southeast the water came across the marsh from the country to the east and began to run into the district about 9 p. m. As stated above it did not get to the highest in the district up towards the river until the middle of the next day. The water fell rather slowly as the outlets to the Gulf were long and tortuous.

In the main the damage to the levee on this district was not great. The wave action in the marsh outside the district was not very great and there is no evidence of any great amount of wave wash on the levees. With the exception of the places where the levee was overtopped the grass was still growing on the levee. The most of the damage was on the eastern side of the district, where the levee was the lowest. For a stretch of several hundred feet the water had poured over the levee and washed some material from the inside slope. The outside slope was undamaged except where the overflow had cut back through the crown. The average depth of cutting was from 1 to 2 feet, but it was not continuous. At one spot about 2,000 feet north of the pumping plant the water tore out about 100 feet of levee and eroded the original soil to a depth of 8 or 10 feet. The depression in the interior of the district extended a distance of about 200 feet from the levee and gradually became shallow. Large bodies of the turf from the top of the land and material from the levee were rolled a distance of 1,000 feet into the interior. It is the opinion of the owners of the property that the break at this point must have occurred very quickly after overtopping. As it was washed much deeper than any of the other breaks it must have occurred earlier allowing the water more time to act. Along the southern boundary of the district the water overtopped

the levee in a low place and tore it out level with the original surface for a length of about 40 feet. The water in rushing into the interior tore up some large portions of the turf or muck. The remainder of the levee on this side received very slight damage. It is the opinion of the owners of this district that if the levee had all been above the height reached by the water that no breaks would have occurred. The levee as a whole was not well surfaced or sodded. In places where the surface was smooth and well covered with the natural grass of the prairie the water had evidently caused much less damage.

Southward from Poydras along the Mississippi River the water came in from the east and southeast nearly to the levees, except on the very highest land. However, from Dalcour, a station about 10 miles below Poydras, to Belaire, a station about 16 miles below Poydras, the water did not come on the cultivated lands along the river. This was due to the River Aux Chenes ridge which is several feet above sea level and covered with thick cypress timber. This ridge branches out from the Mississippi River a little above Dalcour and parallels the river at a distance of several miles to the east. Below Belaire this ridge is lower and not so well protected by timber and did not offer enough resistance to the progress of the water to keep it from the lands along the river. The water came in from the east and southeast and covered all the lands to the levee and in some places overtopped the Mississippi River levees and ran into the river. The damage was greater farther down towards Pointe a la Hache where nearly all small unprotected buildings were moved from the foundation and many of them destroyed.

Pointe a la Hache.—The water at this point reached its highest at about 5 p. m. of the 29th at an elevation of 11.6 feet and was measured by the field men of the State Board of Engineers from marks in buildings that were inhabited at the time of the storm. The water came in from the east early in the day and by noon was running over the Mississippi River levees into the river with a fall of about 3 feet. The overtopping caused a crevasse at this point several hundred feet

long. The back protection levee at Pointe a la Hache has a height of about 9 feet above mean gulf level. This levee was covered with about 3 feet of water. Where the levee was smooth and well grassed it was not washed much, but in a few places the overtopping caused a wash that took it down to the original level. The material was carried into the district only a short distance, usually not more than a 100 feet. It was reported that above and below this point this levee was damaged a great deal more.

Fort St. Phillip.—The water at this point reached an elevation of 11.6 feet. The height was measured by the field men of the State Board of Engineers.

Port Eads.—The height of the water at this point was measured and recorded by a Government tide gauge and reached an elevation of 3.8 feet. The highest water came from the southeast. The land at this point is very low and flat and has no vegetation except grass. The formation is such that very little resistance is offered to the flow of the water. Consequently the water does not pile up as it does where the land is higher or covered with a growth of trees. The observation of residents was that the water flowed across the surface of the land without much interruption.

Burrwood.—The height of the water at this point as shown by the Government gauge was 5.8 feet above mean gulf. The wind velocity at this point was the maximum registered during the storm; the total movement from 3 to 6 p. m. being 320 miles.

Venice.—The highest water at this point was caused by the failure of the Mississippi River levees due to wave action and the water thus came in from the east. The highest stage of the water was marked in Leovy's store and was found by the field men of the State Board of Engineers to be 7.1 above mean gulf. This was the fresh water from the river. When the wind went to the south and southwest this section was protected from the water from the Gulf by a wide stretch of marsh with a considerable growth of willows. From Venice up the west bank of the river for a distance of about 12 miles the salt water did not come in to the levee from the west.

Buras.—The highest water at this point was measured by the field men of the State Board of Engineers from a mark in the Pelican Store and was at elevation 7.7 feet. The water came through the river levees during the middle part of the day and as the wind changed to the south and southwest the salt water came in from the Gulf from the southwest.

Empire (about seven miles above Buras).—The height of the water was measured at this point by the field men of the State Board of Engineers from a mark in the house of Joe Vaccarro and was found to be at elevation 9.3 feet. The water came into this section first from the river and then from the Gulf with the change of the wind to the south. The river levees were very badly damaged in all this lower section. As the wind swung around from northeast to southwest it reached almost all portions of the levee. The greatest damage caused by wave wash was in the long reaches of the river where the wind blew directly up or down the channel. The levee on the west side near Myrtle Grove Plantation was demolished although protected by concrete revetment. The revetment at this point was not reinforced. However in certain sections where the revetment was reinforced it failed under the wave action as the waves broke high enough to take the earth from behind the revetment. However, the reinforced revetment did not go to pieces so badly as that which did not have reinforcing. In certain cases the reinforced revetment was raised back to its original grade and back filled with earth.

Dr. I. M. Cline, District Forecaster, for the United States weather Bureau, states:² That the centre of the storm area passed about 12 miles to the west of the Weather Bureau station, and that the calm area at the storm area was probably 8 miles across. At Waggaman, which is about 11 miles west of the Weather Bureau Station, Mr. T. S. Landry, manager of the Willswood plantation, reports that the wind blew with increasing velocity from the northeast until about 5 p. m. It then began to decrease in velocity and in a few minutes

² For a detailed description of the storm of 1909 see U. S. Dept. Agr. Monthly Weather Review, 1909, p. 623; for storm of August 16-17, 1915, see same publication for August, 1915; and for storm of September 29, see same for September, 1915.

there was no wind whatever. At about 6 p. m. the wind started in from the south and by 8 p. m. was again blowing very hard, but not the equal of the wind of the afternoon.

To the southward of Waggaman the next reliable report on the storm centre was from Mr. Frank H. Adams, engineer of the Louisiana Delta Farms Co., located about 3 miles northeast of Larose on Harvey's Canal. He stated that the wind blew with increasing intensity from the northeast until about 4:30 p. m. of the 29th, when it dropped to a moderate velocity. After about half an hour the wind changed rather quickly from a moderate and decreasing northeast wind to an increasing northwest wind. The hardest wind was then from the northwest. The storm centre must have passed a very short distance to the east of this point.

Mr. Robert Morrison, an engineer located at Cut-Off, about 4 miles south and a mile east of the point where Mr. Adams was located, reported that the wind blew from the northeast during the day until it lulled quite suddenly at 4 p. m. Soon afterwards it started to blow with increasing velocity from the northwest.

The Timbalier Light Station is 34 miles directly south of Cut-Off. The keeper of this light, Mr. J. C. Grey, reported that the wind blew first from the northeast and then after a complete calm started to blow from the southwest. He did not state the time of this calm, but as he reported the highest tide as coming from the northeast out of Timbalier Bay at 2 p. m. the calm area must have reached there sooner.

The track of the storm centre has been platted on the accompanying map and evidently a straight line from Timbalier Light Station to Waggaman will agree with the accounts received from Cut-off and Larose.

Barataria.—During the day the wind blew from the northeast and caused a low tide at this point. After dark, when the wind was around to the southwest, the water came in from the south and reached an elevation of 3 feet above mean tide level. The height of water was observed on the tide gauge at a nearby pumping station.

Manila Village.—Manila Village is a collection of small houses and shrimp drying platforms at the head of Barataria Bay and Grand Bayou. The height of the water was measured from a mark on the counter on the inside of a store which was occupied at the time of the storm. The water reached its highest at elevation 8.00 feet about 2 p. m. The wind blew from the northeast during the early part of the day, but went to east and southeast by 2 p. m.

Grand Isle.—At this point the water reached an elevation of 9 feet, shown by a clear mark in the interior of the store buildings of Mr. Ludwig. This store is near the western end and on the northern side of the island. The highest water was noted about 1 p. m. The wind started in from the northeast and veered to the southeast by noon and blew the hardest about 1 p. m. from the southeast. The height reached by the water in this storm is greater than any other in the recollection of the inhabitants. The storm of 1893, which caused such a great loss of life on Chenier Caminada just to the northwest of Grand Isle was not as high as that last storm. The loss of life during this '93 storm was due to a lack of heavy growth of trees as exists on Grand Isle and also due to the fact that the wind veered to the northwest and carried all debris out to sea. A large majority of the better built houses on Grand Isle stood this last storm without damage, although the heavy growth of live oak trees was evidently a large factor in saving them. A large amount of washing occurred on the beach at Grand Isle. Sand dunes were reduced in elevation as much as ten feet.

A little further to the east on Grand Terre the sand around the Barataria Bay Light Station was eroded considerably. At one point there was a difference of nearly 15 feet in elevation of the sand before and after the storm. The action of the waves carried away a further portion of the brick wall of the southern part of Fort Livingstone.

Cut-Off.—The elevation of the water at this point was observed by Mr. Robert Morrison on a tide gauge set to Cairo Datum and reached a height of 4.7 above mean Gulf at 4 p. m. on the 29th and stayed that high for about 6 hours.

The height of 5.5 feet at Golden Meadows, 9.0 feet at Leeville and 5.5 feet near Little Lake was measured by Mr. Morrison from marks in buildings that were inhabited at the time of the storm. These last four elevations exceed slightly those of September 20, 1909, which were measured by Mr. A. M. Shaw. Both the elevations for 1909 and 1915 are shown on the accompanying map.

To the westward of Bayou Lafourche the winds during the storm of September 29, 1915, were from the northeast, north and northwest all during the hurricane and consequently blew the water offshore. The water going out of Timbalier Bay caused a high tide on Timbalier Island and boats in the upper reaches of the Bay and in Lake Barre report a very low tide during the 29th. After the passage of the storm centre inland the wind velocity was soon checked in this section so that the water was not raised much in the upper end of the Bay and in the lake by the west and southwest winds.

The highest tides experienced in the Timbalier and Terrebonne Bays region were caused by the storm of September 20, 1909. The records of this storm were collected by Mr. A. M. Shaw and the following material is taken from his report written after making the field investigations.

While the track of the storm centre of 1909 was not located very accurately it is the opinion of Dr. Cline that it was to the west of Houma in Terrebonne Parish and probably came in between Houma and Morgan City. This is supported by the report that the upper end of Terrebonne Bay experienced heavy winds from the northeast, east, southeast, south and finally southwest. At Sea Breeze, near the mouth of Bayou Terrebonne the wind blew all day Sunday, September 19, and by Monday morning it was very heavy. As the wind shifted to the southeast the water began to rise and at 4 p. m. it started a very rapid rise. It reached its highest about 7 p. m. and began to recede very soon afterwards. By the next day it was down within 2 or 3 feet of normal. The height of the water was measured from marks in buildings that were inhabited during the storm and are accurate except for the one

from Sea Breeze; at which place the seas were very heavy and the height measure might have been in error 2 or 3 feet.

The extremely high water at Sea Breeze, 15 feet, seems to have been caused by the water being driven in from Timbalier and Terrebonne Bays which are only a few feet deep. These bays also have somewhat of a funnel-shape and the change of direction of the wind from southeast to southwest while it was at the worst would aid in this congestion at Sea Breeze. A rapid drop in the height of the water going inland is apparent. This was due to the resistance offered by the vegetation and the fact that the wind did not remain long enough in the south to cause the water to flow very far inland. At the Gulf side of these bays a tide of only 6 feet was observed by the light station keeper, Mr. Gray, on Timbalier Island. However, this island is only a low ridge of sand and the water did not pile up on it but flowed on across.

All structures on the lower ten miles of Bayou Terrebonne except the camp at Sea Breeze were destroyed. This camp was a two-story framed structure built on long piling driven deeply into the ground. The piling extended up into the second story and formed a part of the frame work of the structure. The floor and walls of the lower story were carried away by the force of the waves, but the second story was only slightly injured.

To the westward of Sea Breeze the storm tide heights were not so great, as the winds were probably blowing off shore during the most of the storm.

The storm which passed near Galveston on August 17-18, 1915, was quite severe and caused high tides along the Gulf Coast from the vicinity of New Orleans to a point about 100 miles southwest of Galveston. However these heights were not above those often reached except from about Morgan City westward. This storm was quite different from the one which visited New Orleans in that the wind velocity was above 25 miles per hour for a much longer period. Twelve hours after the highest wind velocity was measured in New Orleans during the storm of September 29 the wind had dropped to 25 miles per hour, while at Galveston at a like period the wind was still

blowing above 40 miles per hour and the maximum wind for each hour did not drop below 25 miles per hour until 58 hours after the highest wind velocity was recorded. This same sustained wind velocity was experienced along the entire coast from a short distance west of Morgan City to a point west of Galveston. As a result the water was raised much higher than had been recorded at most places and penetrated many miles further inland than ever before.

Attention is called to the greater heights of tide caused at the outlying light stations west of Terrebonne Parish during the Galveston storm than during the New Orleans storm, at outlying stations east of New Orleans. Apparently the sustained wind velocity of the Galveston storm served to pile the water up in the gulf itself, at least for a considerable distance off shore. Naturally the heavy seas that exist at these outlying light stations make it hard for the keeper to measure the mean tide height accurately, but these keepers are accustomed to heavy weather and probably are not in error much. The uniformity of their heights adds a great deal to the probability of their accuracy.

Louisa, Cote Blanche Island.—The postmaster at this point reports that the water was a foot deep on the land at the post-office and that the elevation of the land was 8.5 above sea level making the total rise in tide 9.5 feet.

Weeks, on Weeks Island.—The postmaster at this point reports that the water raised 6 feet on the west side of the island, but that it was much higher in the marsh to the south and east.

Avery Island.—Mr. McIlhenny, owner of a canning factory on the northern part of the island, reports that the water rose 5 feet during the storm and that it went inland to the cultivated land 3 miles north of the island. He also reported that to the south of the island in the marsh the water raised a great deal higher.

Marsh Island.—The height of the water at the west end of the Island on the Gulf side was measured by one of the agents of the Conservation Commission and was found to be 9.5 feet.

Marsh Island, Southwest Pass.—The height of the water at a point a few miles inland along Southwest Pass from the Gulf to Vermilion Bay and at the mouth of Bayou Fearman, was measured by one of the agents of the Conservation Commission and found to be 8 feet.

Schooner Bayou Locks.—The height of the water at the Schooner Bayou Locks was observed on a gauge set by the U. S. Engineers and found to be 5 feet. This lock is located about 5 miles back from Vermilion Bay on Schooner Bayou. On August 16 the height of water at the lock was 2 feet and on the 17th it had raised to 5 feet and on the 18th it had lowered to a little less than 4 feet.

Pecan Island.—The postmaster at this point reports that the water rose 5 feet above ordinary level on the south side of Pecan Island.

East End of Grand Chenier.—At a point 14 miles east of Grand Chenier Postoffice along the south side of the Chenier the height of the water was observed from a mark made by the residents of a house. It was found to be only about 3 feet above marsh level making about 3.5 above mean tide. The water at this point did not reach the highest until the afternoon of the 17th as it came over a long stretch of marsh covered with grass several feet high and also considerable small shrubs. The water finally came into this point from the southwest along the Chenier.

Westward along the Chenier the water was considerably higher and flowed over the Chenier where it was not over 6 or 7 feet above sea level. However, the water did not run over in sufficient quantity or depth to erode the crest any. This Chenier or ridge rises up out of a marsh which is little above sea level, to a height of 6 to 15 feet and a width of from one-fourth to a mile wide. The portion of the ridge to the east of the Mermontau River may have been overtopped before as there are a few breaks through the ridge which have evidently been made either during the formation of the ridge or subsequently. In the vicinity of Grand Chenier Postoffice the ridge was far too high for the water to overflow it. As a result the difference in elevation of the water on the north and south

sides of the ridge was about 5 feet. The height of 10 feet was observed on the south side of the ridge and marked by residents of the town of Grand Chenier. The water was highest very early in the morning of the 17th. The water in the Mermentau River opposite this point and on the north side of the ridge only rose 5 feet. While the water coming into the river where it crosses the ridge about 3 miles to the west the carrying capacity of the upper river was great enough to keep it from getting so high, and the break through the ridge where the river cuts it is comparatively narrow. Opposite the ferry crossing over the river two miles west of Grand Chenier post-office, the water went over the narrow ridge into the river. The ridge was washed out several feet below general marsh level. It is fairly certain that this is the first time this portion of the ridge was overtopped. Trees at least 200 years old were growing at this place on the ridge before the storm water washed them out. Mr. Jones who was the owner of this portion of the ridge said that no evidence of wash around these trees was noticeable before this storm. It is generally accepted to have been the highest stage of water experienced.

Westward along the ridge from Grand Chenier to Cameron the front ridge was covered with water except in a few high spots and the water went inland across the other ridges, but not so deeply. In the low places the water tore through this front ridge with a heavy velocity as a number of channels 4 or 5 feet deep and 40 to 100 feet wide were observed. Evidences were very numerous that this was not the first time this ridge had been overtopped as there were a number of low spots which evidently were washed before this last storm enlarged them. The ridge in this section is only from 4 to 8 feet above sea level. Mr. James Bonsall the mail carrier on the route from Cameron to Grand Chenier states that the water started to come over the ridge about 8 miles east of Cameron by 11 a. m. of the 16th and that within 2 hours the water was up very close to its maximum height. In making his trip that day from Grand Cheniere to Cameron Mr. Bonsall was forced to retreat to the north to the ridges farther inland. In this

way he kept somewhat in advance of the water. The current over the whole country was very strong.

Creole.—The postmaster at this point reports that the water raised 5 feet at his store, and went 8 to 10 miles inland. This spot has been occupied since 1865 by this family and it is the first time that salt water had penetrated as far inland as Creole.

Cameron.—The water reached a height of 10.4 feet on the Government Gauge in the Calcasieu River at 11 p. m. of the 16th. The height was observed and read by Mr. Laurents, Deputy Collector of Customs. The water at this point exceeded all records by at least 3 feet and covered the highest land in this vicinity. At the Calcasieu Light Station about a mile nearer the Gulf the water was measured from a mark observed by the occupants of a house. It was 10 feet above mean Gulf. The highest water was observed about the same time as on the gauge at Cameron. Notes in the daily record book of the light station keeper indicated that the wind continued for 3 days from the southeast and for 48 hours was very heavy. This holding up of the wind was responsible for the water staying over the surface of the land for an unusually long period and the consequent destruction of a large percentage of the orange groves. The beach south of the light station is low and flat and it was soon protected by a sufficient depth of water to keep it from being eroded a great deal.

Grand Lake and Hackberry.—The water in Lake Calcasieu raised rather slowly during the afternoon of the 16th and reached its highest, 6 feet, early the morning of the 17th. While the light docks and boat houses at these points on the lake were destroyed the land was not eroded much, although the bank stands almost vertically at Grand Lake. However the material of the bank is very stiff clay typical of the rice land section.

Calcasieu Lake, North End.—The height of the water was measured at this point by Capt. McCain of the steamboat Rex, which was anchored here. The water rose very rapidly after midnight of the 16th and reached the highest about daylight of the 17th at elevation 6 feet.

Lake Charles.—As Lake Charles is about 50 miles inland from the Gulf, salt water did not reach there until late in the afternoon of the 17th. It continued to rise until the afternoon of the 18th when it reached a height of 5.1 on a gauge set and read by the highway department of Calcasieu Parish.

Johnson's Bayou.—According to the report of the postmaster at this point the water rose about 10 feet above mean tide and covered the highest land of Blue Ridge about 3 feet. The water stayed at or near this height for 6 hours. The water extended many miles inland as wreckage from the ridge was carried 18 miles to the north. This is the highest water experienced at this point, except that in 1886 the postmaster reports that the water came nearly as high at his residence, but soon subsided and did not go but a short distance inland.

Black Bayou.—At the junction of this Bayou with the Vinton Drainage Canal about 8 miles southwest of Vinton, the salt water reached an elevation of 6 feet on August 17. All the land to the westward of the Calcasieu River to the Sabine River was covered with salt water as far inland as the inter-coastal canal, except for some of the highest parts of the Blackberry ridge and one or two other small knolls.

Port Arthur, Texas.—The stages of the water at this point were observed by the local engineers of the U. S. Government and referred to mean low water of the Government gauge at Port Arthur. This datum probably differs somewhat from the Mean Gulf Datum used for reference in the Louisiana section, but the difference is probably somewhat less than a foot.

The highest stages were reached in the immediate vicinity of Port Arthur between 8 and 10 a. m. of August 17. In the Sabine-Neches Canal in front of Port Arthur the water reached elevation 6.9, in the Sabine Lake immediately in front of the city it reached 7.3, and in the turning basin of the canal about 2 miles south it reached elevation 7.6. The waves were quite heavy in Sabine Lake and probably reached 2 to 3 feet higher than 7.3.

The city was protected from great damage by the spoil bank of the Sabine-Neches Canal which was thrown out on the east or lake side of the canal. Without this spoil bank or

levee the waves from the lake would have gone directly into the city and as the water was from 3 to 5 feet deep over a large part of it the destruction of small buildings would have been heavy.

The Sabine-Neches Canal, which has a depth of 25 feet and a width of 200 feet was excavated by hydraulic dredge. The material was deposited by pipe line at a point from 200 to 300 feet east of the canal. For the most part the material was a heavy tenacious clay typical of the rice section of the Gulf Coast. No special effort was made to build the spoil bank into a uniform levee so it is very irregular in shape and cross section. In general it has a height of from 15 to 20 feet and a top width of from 5 to 30 feet. The base is often 500 feet wide. The lower portion of the slope towards the lake is extremely flat, perhaps 50 to 1, but the upper portion of the slope is steeper, perhaps 3 or 4 to 1. On the canal side the slope is 3 or 4 to 1 down to the original surface. The berm is from 30 to 100 feet. Sabine Lake is very shallow for a long distance off shore, at one mile the depth is about 3 feet and the total depth is about 8 feet. The spoil bank above described was fairly well covered with grass. While the waves from the lake broke directly against this spoil bank for a period of at least 12 hours and probably 24 hours no evidence of wave wash were observed or reported. The average water level during the storm was above the flattest part of lake side slope of the spoil bank so the waves must have struck the steeper slopes. However, the waves could not have had much force after traveling over and up such a long and increasing slope.

Sabine Pass.—The height of the water at this point was also measured by the local engineers of the U. S. Government and was found to be 11.2 feet. The keeper at the Sabine Pass Light Station reported 10.9 feet. The keeper at the Sabine Bank Light Station, about 15 miles out in the Gulf, reported a rise of 10.6 feet, about midnight of the 16th.

At the entrance to the Sabine Pass the jetties which were under construction were damaged about \$300,000. A considerable length of the east jetty had been built up from elevation about minus 25 feet to about elevation about minus 10 feet.

The stones in the jetty were mostly large granite blocks of 10 tons and upward. The side slopes of the jetty were about 2 to 1 and the top width about 50 feet. A considerable portion of the outer end of the jetty was leveled down so that its width was 300 feet. The eddy currents around the large blocks tore out the soft mud foundation so that at present the top of this broad layer of stones is below the original bottom elevation. The jetty on the west side of the pass was not damaged much. Where the jetties were completed and above ordinary water level the damage was not so great, but the completed jetty was farther inland and did not get as heavy wave action as the portion damaged so severely.

To the westward of Sabine Pass the stages reached by the water were considerably higher. The first point west at which a height was obtained was at High Island where the water raised 14.4 feet. The stage of the water at this and all points westward in the vicinity of Galveston and as far as the mouth of Brazos River was referred to the mean low water datum of the U. S. Engineers gauge at Galveston by field parties from the Galveston office of the U. S. Engineers and by the engineers of the Sante Fe Railroad. These parties spent a considerable period in the field immediately after the storm and the stages given are accurate and reliable.

The heights of the water at the other stations to the westward are given in the accompanying table and shown on the accompanying map. Reading then in order as they come geographically in going west to Galveston and then to the north around Galveston Bay and on to the west they are: Roll Over, 13.9; Port Bolivar, 11.5; Galveston, 11.7 to 12.4; Double Bayou, 13.0; Anahuac, 14.4; Wallisville, 13.1; Morgan Point, 13.8; Sylvan Beach, 15.1; Sea Brook, 15.0; San Leon, 15.2; Texas City, 14.0; Virginia Point, 15.3.

The storm centre passed between Galveston and the mouth of the Brazos River. No marks were obtainable to the west of Galveston except in the immediate vicinity of the mouth of the Brazos River. At Surfside, immediately to the east of the mouth of the river the water reached elevation 14.2, and just west of the mouth at Quintana it reached 13.8. At the Brazos

Light Station the height was 14.8 above mean low Gulf and at Oyster Creek about 4 miles in the interior it reached elevation 10.5. At Velasco the height was 8.8, at Freeport 9.8 and at Bryan's Mound a little farther west from Freeport it was 7.0.

At No. 714 Tremont Street in the north part of Galveston a record was kept of the rise in the height of the water after it had reached elevation 8.3 at 7:30 p. m. on the 16th. The record is as follows:

Time	7.30	8.10	8.30	9.00	9.30	10.00	10.50	11.15
Elevation	8.29	9.20	9.46	9.79	10.19	10.42	10.79	10.87
Rise in feet		0.91	0.26	0.33	0.40	0.23	0.37	0.08

This highest stage of the water was evidently caused by the water coming in from the east as wind was at that time in the N.E. or E. and was then at a maximum velocity for 5 minutes about 80 miles per hour. The lowest barometer reading was experienced at 3 a. m. of the 17th and the highest wind at the same time from the S.E. Quite soon afterwards the wind went to the south and then caused the highest water on the southern portion of the island.

A somewhat similar record was kept near Velasco on Oyster Creek. On August 17 at 9 a. m. the water was elevation 9.56; at 9.20 a. m. 9.81; at 9.40 a. m. 9.96; 10.00 a. m. 10.23; 10.30 a. m. 10.46. The rise at this point was thus largely due to the wind from the S.W. and S., blowing towards the storm centre after it had passed inland.

Bolivar Peninsula to the east of Galveston suffered very heavily from wave wash. The line of the Sante Fe Railway was destroyed from a short distance west of High Island to the end in Port Bolivar. The grade line of the track was from 6 to 8 feet elevation and the waves picked up the track and used it as a battering ram to break up the houses that were built immediately north of it. In many places the entire right of way of the railway was washed away. The line had to be relocated for a considerable distance and new right of way secured. In the interior of Galveston Bay the damage was not so great except in the northeast corner where, low land surrounds the entrance of Trinity River, and on the Western side in the vicinity of Texas City. The map shows the limit of

overflow. The damage to structures in and around Galveston has already been covered very completely in various publications. However, to view the great stretch of sand taken away from behind the sea wall to the east and west of the Galvez Hotel was impressive. The average depth of excavation east of the Galvez was perhaps 6 to 10 feet for an area of 5 or 10 acres behind the sea wall. Near the Government reservation to the west of the Galvez the area was somewhat greater, but the average depth of excavation was not so deep. This sand was without any mixture of silt or clay and was readily torn up by the water that broke over the wall. The sand was carried back into the interior of the city by the force of the waves and current. As a result of the continued wind from the south the water was held in Galveston Bay at flood heights for an unusually long period. This long submergence with salt water killed all trees in the city except palms of various varieties. Trees which had lived through previous storms were killed.

To the westward of Velasco the severity of the storm was less and except for the water being piled up in the east end of Matagorda Bay to a height of about 10 feet no excessive stages were superinduced. This portion of the coast has its bays protected by outlying strips of land. At Matagorda the highest water was experienced about 8 a. m. of August 17 with a southwest wind which piled the water up to elevation 6 feet. But as the land is high immediately on shore no damage was done except to shipping. At Palacios the highest water, 5 feet, was experienced about the same time with a southwest wind. No very great amount of land is possible of overflow on this section of the coast as the land is all at a considerable elevation above the Gulf.

It is difficult if not impossible to draw any general conclusions in regard to tides caused by tropical hurricanes. However, it is believed that it will be of value to summarize the facts that were observed in the investigations. The highest tides and the greatest damage seem to be always east of the track of the storm centre, and the effect of the disturbance usually extends farther to the east than to the west. Local

differences in character and shape of coast line will sometimes make the opposite true, and regions fairly close to the track, whether on the east or west side, will suffer. The height of the tide depends on the intensity, duration, and direction of the wind and on the shape, elevation, and exposure of the coast line. The off shore depth of water will also have some influence and the nature and amount of vegetation on the land will have a great influence on the height at points not immediately on the shore line. Funnel-shaped bays facing directly towards the hardest wind are likely to have the heaviest tides as shown by the records at the upper end of Timballier and Terrebonne Bays and at the southwest end of Lake Pontchartrain. Low, barren strips of land like that near Port Eads and islands like Timballier which allow the water to pass on across without much obstruction are not likely to experience as high tides as land which is higher, or covered with trees, or a portion of the mainland which is covered with a heavy coat of tall grass. The rising water flows inland with considerable velocity and naturally piles up on any obstruction, such as a railway embankment or strip of heavy timber. Usually sufficient time is not allowed for the water to assume anything near a level stage over any considerable area and great differences of level are to be expected in a short distance, especially near the limit of overflow or where the flow of water is obstructed. This is shown by the heights observed south of Houma on Bayou Terrebonne and between Michaud and Lee Station on the L. & N. Railway. Quite often there occurs a shifting or even a reversal in direction of wind as the water reaches its high stages which will cause great local differences in stage. Points which are a long distance from bodies of open water have not experienced overflow from tides as the water does not have sufficient time to travel inland and heavy strips of timber retard the flow of the water to a remarkable degree.

No method of forecasting the maximum height of water to be expected at a given point seems possible. However, as the very highest stages recorded during the last three storms are the highest yet experienced in those comparatively limited areas, it is not likely that they will soon be exceeded. In the

other areas higher tides might be caused by storms striking the coast at a different point, and future storms will undoubtedly cause tides which show a different variation between the various localities than the tides already experienced. It is suggested that in estimating the height of tide to be expected at a given point that an area in the region of the maximum recorded tides similar in all features to the one in question be selected for comparison. As future storms may exceed in both intensity and duration those of the past a margin should be allowed for safety.

All structures but those of reinforced concrete well back filled, which were exposed to the direct action of the waves from an area of open water were demolished. Comparatively light structures which were above the reach of the waves were not seriously damaged. Rather light structures which were situated in the open marsh at a long distance from open water were secure even though having several feet of water over the floor. Apparently the wave action across grass covered marsh was not very heavy even when flooded from 5 to 8 feet deep. Structures in exposed places should be built above the reach of the waves.

The foundation should be of substantial piling driven deeply into the ground and extending up into the main part of the structure. All such parts of the structure as are down near the level of low tide should be of light construction so that they will be easily washed away and not endanger the main part of it. The building of small fishing camps and clubhouses in and is responsible for a majority of deaths during storm tides. exposed places only a few feet above the low tide is suicidal. The building of all such structures cannot be condemned too strongly."

Earthen and sand embankments and beaches having very flat grass-covered slopes were not greatly damaged unless overtopped. Resulting sand beaches along the Mississippi Coast were almost uniformly left a slope of 20 to 1. Sandy beaches well grass-covered resisted the waves fairly well when the slope was at least as flat as 12 to 1. Grass-covered embankments of typical alluvial similarity with a slope of 4 or 5 to 1

which were protected by a wide stretch of marsh were not damaged by wave wash with the water ten feet deep over the marsh. Other embankments not so well grass-covered and of the same material and with slopes of 3 to 1 were not damaged by wave wash when the water was 5 to 6 feet deep over the surrounding marsh. Embankments of all kinds were badly damaged when the water overtopped them. The levees along the Mississippi River were badly damaged and in places demolished by wave wash. Even when revetted with concrete they were not secure as the waves were high enough to overtop the levee and wash out the material from behind the concrete. Where the concrete was not reinforced the slabs of concrete were washed a considerable distance from their original position. Reinforced concrete revetment on the levees stood the wave action much better. As the water in the river was very deep the wave action was very heavy. Such portions of the levees on the districts at LaBranche, Poydras and Bayou La Loutre as were well surfaced and sodded stood the overtopping with a very small amount of erosion.

Levees to keep out storm tides should be at least 2 feet above expected high tide, in protected locations and 3 to 5 feet in exposed locations. Where the levee is not near an open body of water and the water will not get more than 4 or 5 feet deep in the surrounding marsh no wave action of consequence should result and side slopes of 3 to 1 should be sufficient. Where the water gets 6 feet or more over the surrounding marsh considerable wave action might result, but side slopes of 4 or 5 to 1 if the material is sticky and impervious should not be affected much. All levees should be well surfaced and sodded with Bermuda grass. Earthen embankments on large bodies of open water will have to be very flat unless protected with reinforced concrete revetment. Unprotected embankments in such location should have a slope of 10 or 15 to 1, depending on the material, and be well sodded with Bermuda grass. Where levees are to be built to protect areas of marsh land on the immediate coast line it is believed that a strip of land should be left as a foreshore. This strip should be at least a quarter of a mile wide and wider if the exposure is

particularly great. This foreshore should be thickly planted with some rapid growing trees. This belt of timber will prevent wave wash on the levee and a slope of 4 or 5 to 1 should be ample. If such protection is not afforded the levee it should be at least 4 feet above expected high tide and have a much flatter slope.

In building drainage pumping plants to meet conditions prevailing at times of storm tides it should be remembered that excessive rains accompany tropical hurricanes. If the plant is located where the tide will fall rapidly a large increase in the horse power over that necessary at ordinary tide levels would probably not be justified, but if it is likely that the tide will remain high for several days, the plant should be so designed as to be able to handle its full capacity at this increased head. The construction of the building should be such as to protect the machinery from the heaviest wind. As the stacks to the boilers in steam plants are often lost during hurricanes, internal combustion engine driven plants are more likely to be able to operate. Every effort should be made to make the pumping plant independent of conditions around and adjacent to the district principally, by having always on hand an ample supply of fuel. Plants which are driven by motors are dependent on conditions along the power transmission line and at the central power station as well as conditions on the immediate district drained.

DISCUSSION.

THE PRESIDENT: Gentlemen, every engineer who has done any considerable amount of field work appreciates this question of having data on high water at various points, and we can readily appreciate the value of this carefully prepared paper on the territory which it covers. It brings together all this data which Mr. Okey has collected and puts it in shape so that it will be of very great benefit for all future time, and I feel that Mr. Okey has made a great contribution to this question. We would be glad to have discussions on this paper, and no doubt, Mr. Okey would be glad to answer any question that anybody desires to ask him. We will be glad to hear from anybody who feels disposed to discuss it.

I suppose Mr. Okey has covered it so thoroughly that nobody feels that there is anything to ask. Mr. Shaw, you were mentioned in this paper several times. Maybe you would like to say something.

MR. SHAW: There is one thing that occurred to me, and that is this, that when I secured those high-water marks which Mr. Okey refers to, according to the testimony of the oldest inhabitants, which we always go to, and which we sometimes depend on, those marks were the highest known. Now, Mr. Okey comes along and tells one better. I think we had better see to it that Mr. Okey is kept in this territory and we don't get a third man who will come along with a still higher set of marks.

I did have in mind quite a valuable addition to this paper which I thought would come in very apropos at this time, in the nature of a set of conclusions to be drawn from the observations which he has made, but unfortunately for me, he summed them up in his own summary, and thereby stole my thunder. But I think it might, perhaps, be well to simply emphasize some of the points which he brought out as applying particularly to the land reclamation work which we are doing here and the protection of exposed points. It is very clearly shown in his paper that there is a great difference between the wave action at points exposed to deep water and the wave action at points exposed to water which

overflows the prairies at ordinary depths, say 4 or 5 feet, and I think that those of us who are vitally interested in works bordering water of that nature can take some comfort from the experiences shown. Now, for instance, at Myrtle Grove, we have a depth of a hundred feet or more of water, and during the very moderate storm of 1911, I believe it was, I happened to be at Myrtle Grove and noticed the wave action at that exposed point. There is a reach of river several miles in length, and the wind was blowing directly up the river, and the waves were very similar to what we see in the open sea, and in the period from nine o'clock in the morning to half-past twelve, those waves, with the assistance of a very small amount of drift and a few logs, had battered down the timber revetment, had torn loose the almost perfect Bermuda sod with which the levee was faced, and had cut through the levee of river silt and had carried away the ground and was working on the back slope. Velocities of wind very much greater than that, blowing for a great deal longer period against levees built not nearly with the care that that was, and only very superficially protected with grass, bordering these prairies, have not appreciably damaged those levees, and I think that that ought to show to us that it is not entirely hopeless to build levees which will be safe on these Louisiana prairies, even with the wave action which we are liable to have. The question of slope and covering the levees with grass I consider of most importance. The opportunities which I have, unfortunately, had to observe the action of the high water on these levees would show very conclusively that everything that can be done with regard to getting the grass started on the levee and getting the proper slope, of course, first of all, getting the crown above the high water which will occur, are all important factors in the safety of the levee, and I don't believe that, except in especially exposed points, we have got to go to the expense that some advocate, of putting up timber or other revetments along these levees. I believe it is perfectly feasible to build a levee in a typical Louisiana prairie that is protected from open water, or deep water, in a permanent manner.

There was one example of deep erosion which Mr. Okey mentions, in which I think perhaps the great depth to which the

erosion took place was possibly not obvious on the surface. That was the Philips Land Company tract, where the levee broke through and there was a great erosion below the natural surface. It just happens that at that particular point there is a spit of quite coarse, clean sand, running diagonally through the territory, with a very slight covering of muck, and no clay over the sand, and as I recall the location, that was right where the deep scour took place. I don't think it was due to any peculiar concentration of the storm, or any particular failure of the levee beyond what might have occurred at any other point, but the subfoundation was unique at that particular point, and probably accounts for the unusually deep erosion below the natural surface.

THE PRESIDENT: Has anybody else anything to say to us this evening?

MR. COLEMAN: My friend Mr. A. M. Shaw reminds me that I have not made any speech yet.

THE PRESIDENT: We would be glad to hear from you, Mr. Coleman.

MR. COLEMAN: I don't know that there is very much that I can say to add to what has already been said. The question of tidal elevations and the effect of storms on coast lines has been very thoroughly covered by Mr. Okey's paper. Most of us in Louisiana have regarded information of that nature more with respect to the effect which it would have on these land reclamation projects, and comparatively few of us had given very much thought or study to the problems which have been confronting the people of the Mississippi coast, or the greater part of the Mississippi coast,—I think we might say also the Alabama coast, and parts of the Florida coast, in so far as the Gulf of Mexico is concerned—but it is a fact which all of us know, even though we may not have given much thought to it, that the action of these storms, particularly on the Mississippi and Alabama coasts, has been to gradually erode those coast lines, and to, if unchecked, ultimately materially destroy the beauties of those coast lines. We of Louisiana, and particularly this part of the state, in large numbers spend our summer seasons at the attractive resorts along the Mississippi coast, and many of our citizens are

the owners of property in those Mississippi coast places. We have spent large sums of money from time to time to rebuild bath-houses and to otherwise repair damage which has been done by storms on that coast. There seems to have been no concert of action in any of this section of the country towards works of protection against this damage until about now, and a concert of action now seems to be principally in an awakened sense of the necessity for doing something. There has been no concert of action to the extent of trying to arrive at some standard plan, and it seems more or less a pity that with the enormous sea coast, or gulf coast, which needs protection, there should not have been evolved a commission to represent the entire coast, from Pearl River to the Mississippi-Alabama state line, which could easily have afforded to engage the services of a Board of Engineers who have given special thought and study and consideration to these questions, so that they might have evolved a satisfactory plan within the means of all the interested parties.

It is unfortunately true, as has been stated by Mr. Shaw, of Gulfport, that the means which are available for that character of work are perhaps lower than the task, itself, would justify. The situation there is one in which the garment must be cut to fit the cloth, and the cloth is, perhaps, inadequate. However, with so much at stake, it seems advisable or desirable for all of the interested parties along the coast line to have participated in such expense as would have been necessary to have evolved that plan which for the least money would have given most protection. In so far as my personal views are concerned, I am of the opinion that Mr. Shaw has been peculiarly successful in arriving at a plan which, for a given expenditure, will achieve, perhaps, the best results, but in much counsel there is wisdom, we are told, and I think, perhaps, if we could have drawn a large number of engineers into the study of these problems, we might possibly have evolved even a more satisfactory plan. In so far as our Louisiana properties are concerned, I feel quite sure that Mr. Okey has outlined the proper course of procedure for us. This reclamation of marsh lands at or very near the sea coast will necessitate a levee construction of the type indicated by him, and particularly, will necessitate in the most exposed places the

great depth of fore-shore which he recommends, and the planting on that fore-shore of some quick growth, like willows, or cane, or whatever of that nature we might find that will serve to break the force of the waves. I believe, with Mr. Okey and Mr. A. M. Shaw, that there is no question of our ability to build and maintain such levees as will be necessary for the success of these reclamation projects, if we are granted a reasonable amount of money with which to do that construction. I think the properties which are subject to reclamation are of such nature and such value that they can well afford to subject themselves to such taxation as will provide sufficient means with which to build levees of the type needed for their protection, and I look forward to the day, at no greatly distant future time, in which we will see the comparatively small areas which are blocked out on the map which Mr. Okey has hung on the wall as reclaimed areas gradually connected up with each other until the reclaimed areas on our gulf coast will form the larger percentage of the lands on that coast. May the day come soon.

MR. MUTH: I would like to ask Mr. Okey if any determination was made of the intensity of the wave force under natural conditions.

MR. OKEY: No, sir, not that I know of.

PERSONAL EXPERIENCES OF A CANADIAN SOLDIER IN BELGIUM.

By

J. W. FAIRLIE.

An address delivered before the Society June 12, 1916.

Mr. President and Members of the Louisiana Engineering Society: The particular subject that I want to talk about to-night is somewhat difficult, for the reason that it is hard to describe a personal experience, because, as you know, as a unit of any command, or of any regiment, you have so small an opportunity to find out what is really going on; your experience is entirely devoted to sticking where you are told, and doing exactly as you are ordered. I think the better way to get out of it would be to describe to you the journeys and experiences of the first Canadian contingent, of which I had the honor to be a member. As you know, war broke out in August of 1914, and immediately a call came for volunteers. Every man, of course, in Canada, and a number of other places, wanted to go to the front, and the first statement to the Canadian militia was that only twenty thousand men would be accepted; that meant that those twenty thousand men had to be distributed over all the Canadian provinces, and consequently there was quite a rush to be one of the first contingent. Finally, however, it was extended to thirty-three thousand men. After undergoing medical examination, and a few other things of that type, we fixed up our private business, and were enlisted into the 50th Gordon Highlanders, stationed at Victoria. The other regiments which sent detachments to the front from Victoria were the Eighth Detachment of Artillery, and the 88th Fusilliers. We were allowed quite a lot of liberties as soldiers, and then were ordered to embark for Valcartier, which was the military concentration camp for Canada, and, of course, we had twenty-four hours leave to say good-bye and to finish up whatever we might have to do, and then embarked on board the boat in Victoria harbor, going over to Vancouver, and taking the transcontinental line to Valcartier. While on the way, everybody, of course, gave us a right royal treatment, and helped us

out with magazines and other things to enable us to pass our time pleasantly. When we arrived at Valcartier, of course, the real business of the war began, as we understood it.

Being enlisted in the Gordon Highlanders, but trained as a cavalryman, I immediately got exchanged into the Royal Canadian Dragoons, which is the senior cavalry regiment. The next trouble that we had was getting our mounts. Nearly all the Canadian regiments, that is, the regular regiments, were skeleton regiments, probably not amounting to more than sixty men to a squadron, which should be about one hundred and eighty men. As a result, there were not sufficient mounts to go around, and we had to obtain fresh ones, which were unbroken, and it was quite an exciting little job to break these horses in, so as to use them. I remember the first time we had a mounted parade. We led our horses out to the parade ground, and the order was given to prepare to mount. That was quite all right, as far as the men were concerned, but quite another story with regard to the horses. They all decided they wanted to go somewhere, and they went. Instead of a regiment of men on parade, we had only a squadron of men scouting all over the country trying to navigate as best they could.

After four or five days spent in military exercises, and rough riding, we got orders to have all our equipment properly packed, and then went en route to Quebec, where we embarked on steamers lying in the harbor for us. I had had some little experience with army transports before, and was naturally surprised to find that we were allotted to the second class on the steamer *Lorentic*, one of the finest ships in the Atlantic trade. Consequently, when the First Battalion of Infantry were put on board, they had to put up with third class and steerage, which immediately caused bad blood between the cavalrymen and the "gravel crushers," as they are called. The main trouble really started with the policing arrangements; one day the infantry men were assigned to this duty, and then the cavalrymen, on the following day, would provide the police detail. It is very hard, when you have quite a number of men who don't want to do as they are told, to bring them into line, and they acted accordingly. Several

times real damage was only averted by the strong hand which was held over the men.

Every day, we had an hour, in the morning, of calisthenics, while we were on board, and I am sure any professor of calisthenics would have had a shock if he had seen the foolish antics we were put through, as each officer had a special idea as to what constituted good exercise. In the afternoon we had a lecture, on various subjects, such as the care of horses on the route of march, outpost duty and similar things of which the men were supposed to have a good understanding, and the rest of the day we were allowed to lounge around and do as we liked.

We were eighteen days from the time we left Gaspé Bay until the time we entered Davenport Harbor. Where we were those eighteen days I don't know; we were steaming along at the rate of 18 knots an hour.

Also, the officers religiously practiced "Orderly Officer" duty. That meant that any man who had the misfortune to be detailed for pickets and sentry duty, didn't get any sleep for twenty-four hours, because not only one orderly officer, but seven or eight, would practice at the duties of the orderly officer of the day. So that as soon as you got off duty and were prepared to get a few minutes sleep, the command would come: "Guard turn out, Orderly Officer," and he would go through the whole detail as religiously as possible and consequently you couldn't get any more sleep that night.

That kind of thing, that is, playing at it, for that is all it was, got the men's tempers so ragged and sore that they were hard to handle—also, owing to the fact that supplies on the ship ran out, and you couldn't get any tobacco or matches or things of that kind, and, of course, no drinks or intoxicating liquors were allowed on board, except for the officers.

When we got to Davenport, we lay in the harbor two days, then disembarked on the third day, each man taking two horses and leading them to the railway station, arriving at Amesbury at 11 o'clock in the early morning. It was raining, pitch dark, and we were told the camp was three miles away. We marched until seven-thirty in the morning, and when we got to the place which was to be our camping ground, we found no tents, no

camping arrangements, not even any breakfast for the men. We had had nothing to eat for twenty-four hours. After picketing the horses, we were told to get our breakfast as best we could.

The first three days we had in England were the only three fine days that I can remember from the time we landed there until I left, on the first of May. That is to say, it rained some part of the day, every day during that time, both in England and in France.

We were under canvas all the winter time—also the Canadian cavalry brigade were the only regiments under canvas during that winter, there being some misunderstanding with the high command as to what should be done with the cavalry.

After getting as much discomfort as possible, we were told that we would be placed in billets. We had visions of nice fires, clean clothes, and also the privilege of having a wash once in a while. When we landed at Tilshead, about fourteen miles from Salisbury, some of the men, to reach their billets, had to walk in water past the waist, owing to the fact that the run-off from the downs had flooded the whole of the surrounding country. We were better off in the tents than we were, actually, in the houses.

We stayed in Tilshead about two weeks, and then moved on to Mersfield, which is practically eight miles from Brighton, and was also the estate of the Prince of Munster, one of the German princes, which had been confiscated by the British Government and turned into a British cavalry camp. That was the most comfortable camp that there was, I think, in the whole of Great Britain, owing to its particularly ideal conditions and perfect drainage.

Owing to some mistake, there were no bathing arrangements made for the men, and a number of the men, including myself, took a trip to Salisbury in order to get a bath, and on arriving back again, we received eighteen days field punishment, which is a lot more exciting than eighteen days cells, inasmuch as after you do all the little odd jobs around the camp that nobody else likes to do, you are tied to a wagon wheel the balance of the evening, a very uncomfortable proceeding,—but that is what they consider field punishment.

One morning in November, about the 14th, we were out on an exercise ride, and at eleven o'clock, an orderly rushed up to the commanding officer with a message, which was that we were to entrain at once. We returned to camp at full speed and turned our horses over to anybody that would take care of them. Each man was given a great coat and haversack, and we got into a number of motor transports and were rushed to the station. From there, we got down to Folkestone, embarked on one of the Channel steamers to Boulogne, thence to St. Omer, and from there by motor transports to Ypres, where we finally landed. It was eight hours from the time we left England till the time we reached the firing line. What became of the horses and the rest of our personal equipment, I don't know. None of us ever got an opportunity to see them again.

At that time, the English forces were hard put to to hold the line of trenches that they were in possession of then, and every available man, it didn't matter whether he was infantry, cavalry or even artillery, was pressed into the ranks and given a rifle and bayonet and rushed into the trenches, so as to give the men holding the trenches a rest. They had been nineteen days or so without any break, and they didn't have sufficient reserves to risk changing the men without possibly a chance of losing out. We had been longing for a quite a time, of course, to get to the front, because it was, under the circumstances, far more comfortable at the front than it was at home.

The chief difficulty about the trenches is not so much the fighting, but the discomfort under which you fight. The trenches, at the beginning of the war, were just made out of the ordinary earth, with a revetment wattle fence, and the tremendous rains which we had, and, of course, the heavy bombardment to which the trenches on both sides were subjected, made them pretty soft—almost a cesspool, you might say. There was no chance of getting these trenches cleaned out. The trenches were never empty: one line of men held them until the relief came in, and then fell back and marched out through the connecting trench to the base in the rear.

The effect, of course, to a man who has never been in action before, is rather peculiar, and naturally, every man, when he first

goes into the field, does quite a large amount of ducking, and all the rest of it; you can't help it; it is instinctive. You just hear the bullets whizzing over your head, and, of course, you just naturally drop, that is all there is to it. After the first two or three hours, you know it is of no use; you have to stay there, and while you may desire strongly to get to some more sheltered place, you have to stay and do as you are told; there is no chance of your getting out. I only know of two cases where men were shot for cowardice, and they were probably two of the last men that one would expect to be of that type, as one was a color sergeant and one a sergeant-major in Imperial Regiments. The men were not found at their posts, but at quite a considerable distance in the rear. No time was lost; a court-martial was immediately convened, and they were taken out and shot. I don't think the time that elapsed between the arrest and shooting was over six hours. It was short and sharp. We all feel we would like to get away, but, of course, there is not a possible chance, even if we do feel like it.

Trench life is very uncomfortable, outside of the fighting, owing to the fact that you have innumerable friends (?) that you would like to get rid of, but there is no possible chance of that either. Two hours after you are in the trenches, you are as uncomfortable as you can be. After you have remained in the trenches two or three hours, you get a little used to it. You can't do anything with it—you are kept busy doing other things, so possibly you might forget it for a little while, until you want to get a little sleep. When there is not a great deal of activity on the enemy's line of trenches, half the men "Stand to," and the other half are told to get what little rest they can. The dug-outs are little recesses in the sides of the trench, and three or four men will get in a little space ten by three and huddle up as best they may, and will get what little comfort they can out of them; also cook their hard-pan biscuit, if they get a chance, or eat them cold. When you go to the firing line, you are given twelve ship's biscuits, or dog biscuits—they are the same thing as dog biscuits—and a tin of jam, which is nothing more or less than turnips and flavoring—no jam in it, as jam goes—and a tin of "bully" beef, which is compressed beef. That is your ration for twenty-

four hours. You can do as you like with it; you can eat it all at once, or hold it as long as you please. Sometimes a man will take the whole mess together and boil it and try to make a stew out of it. That really is the only way that you can eat it with any sense of enjoyment. Of course, you are hungry, and are glad to eat anything, but you think of the fine dinners you used to have and the fine dinners you will have if you ever get out.

After the Regulation four days in the trenches, you are supposed to be relieved. The question of relief is one which is adapted to circumstances at the time. If the bombardment is severe, and there is no opportunity of relieving you without considerable loss, you will have to stay much longer. Naturally, that is why the heavy bombardments are conducted. They shell the supporting trenches, and by the intense artillery engagements, they prevent your supports from coming up, and that is half the battle.

When you do get relieved, you are taken to the base, about eight or nine miles away, and you get a bath, which is quite a considerable item, I can assure you, after being filthy and all the rest of it for days at a time. They issue you a clean shirt and a clean tunic, and you are told to go to sleep. Well, maybe you can sleep and maybe you cannot, owing to your nerves being in a pretty much shattered state. After twenty-four hours, you are taken out and given a little exercise, in the shape of hitching forty men to a 4.7 gun and pulling it around in a circle for a quarter of an hour at a time. That is to keep you in condition. It is even worse than fighting, and far more tedious—and all other little jobs whereby your muscles can be strengthened and your body toned up, you get to do,—such as pulling water carts, hauling transports out of the mud, carrying ammunition—anything at all to keep you busy and out of mischief. In the evening—you finish generally about sundown; that is when taps is sounded, as you would call it here, you are allowed from then until lights-out to do as you like, but you can not wander out of the confines of the camp; you cannot get past a sentry, neither can anybody come within your own lines without a pass from the officer in charge. If any man is caught wandering around without a pass, or any man wishes to give himself up, as sometimes

happens, or a man is captured, or wants to come in with a communication of any kind, or wishes to visit the camp, he is blindfolded and taken to the provost sergeant, who has full charge of the policing arrangements of the camp—and they are very strict. Everybody is searched. There is no chance in the world for anybody to get into a camp to take pictures or sketches or get any information in regard to the modern military camp. Any stories which you might hear to the contrary are not correct, because the sentries extend out for three or four miles all around the camps and you cannot get to the firing line at all.

There is a sort of understanding between the sentries of the opposing armies that unless a considerable amount of activity is heard, the sentry does not give an alarm, and they do not fire at one another. When you are doing sentry-go, you do not stand up in front of the trench and walk around in the ordinary way, you lie flat on the ground. There is much less chance of being hit, and besides, the snipers are generally busy trying to pick out the officers and "N. C. O.'s" if they can see them. That is the only excitement a man can get in the trenches, between the times when he is really busy. If a man is a good shot as a sharpshooter, he can get permission from his commanding officer to go and wander around and do all the damage he can to the other side, and naturally, the other side takes full advantage of the same thing to return the compliment. A good many men and officers on both sides have been lost owing to the activity of the snipers, and these are very hard to locate when you take up a new position. After a while, when the artillery gets into full action, there is very little in front of the opposing lines—right in front of the lines that we were holding, I don't remember seeing a single house or a barn, and but very few trees which were left standing, owing to the intense bombardment. If the Germans left them standing, the allied armies would demolish them, themselves, owing to the fact that they might become blockhouses, holding command, probably, of the trenches which we were holding. Any obstruction of that nature is immediately blown up, and there is nothing but the bare ground in front of the line of trenches. The opposing trenches vary in distance from 60 yards to 400 yards, and I don't think they are much more than 400

yards at any point of contact. Sixty yards was the distance the German trenches happened to be from ours, and between actual fighting times, we used to amuse ourselves by throwing jam tins—and sometimes the meat—across the lines, when it wasn't very good, putting it on a long stick, and throwing it over. They would likewise send over the portions that they didn't want. Of course, it all added to the general mess you were wallowing in at the time, and, while not very exciting to anybody on the outside, it helped to pass away the time.

The most exciting time one can experience, I think, is when the order comes to charge. Of course, there are no alarms sounded by bugles; every order is given in a subdued tone, either by a low whistle or voice, and it is passed down the line. You get the order to "Stand to;" every man fills his bandolier, which is made of paper, and as soon as you are finished with it you throw it away. You fix your bayonet on your rifle and stand right to the trench waiting for orders. You may stand that way for hours, sometimes for twenty hours. You don't know what the order is going to be—you don't know whether the opposing side is to attack you, or whether you will do the attacking. When you get the order to "Charge," I don't know what happens, really; I think everybody goes crazy. They must, because if you stop to think a minute, I don't believe any sane man would get up there and rush into a thing of that kind if he were sure of what he was doing. But you get a body of men together, and an order comes to charge, they just naturally charge, and a man then ceases to be a man,—he becomes a machine or an animal, or whatever you like to think about it. And to some degree, that is a good point about it, because a bayonet charge is not the nicest thing in the world for anybody to engage in, outside of the fact that the other man is firing at you, and I can assure you a man can run a hundred yards in very good time when the other man is helping him along. One cannot remember very much about the incidents of a bayonet charge—at least, I do not. I know I had the good fortune to go through two of them without any more hurt than a smash on the wrist from the butt of a rifle. There were many others, of course, who were not quite so fortunate.

The effect of modern artillery is rather astounding. The high-explosive shells which the Germans used in the beginning of the campaign were an intense surprise, I think, to the allies,—at least, they were to the British and Canadians. The heaviest gun that the Canadians took over with them was a 6-inch field gun, the majority of the guns, I think, being 4.7's, and when the Germans began to use their 17-inch Howitzer guns, we had nothing with which to reply to such heavy bombardment, and that probably accounts for the heavy losses to the Canadian troops during the early part of January and February; we were simply at the mercy of the German artillery, and it was not until some time about the second week in February that the allies obtained—where they got them from, I don't know—some heavy artillery, and were able to at least reduce the German fire to some extent.

The high-explosive shell will make a crater about 30 yards in diameter, which means that if it explodes anywhere near your works, they don't remain any more—they blow it all up. I remember one morning we went into action about 10 o'clock, and by half-past eleven,—or rather, I should say at 10 o'clock we numbered 860 men in our particular detachment, and by half-past eleven there were not two hundred men that could stand up and answer the roll. That takes place very often, and takes place on both sides. At the present stage of the game, as I understand, neither side has any great advantage in the matter of equipment or in the matter of military knowledge. The Germans, I think, have a greater organizing capacity, and the losses on both sides are tremendous. The British have lost, up to the present time, more than three-quarters of a million men killed, not counting the casualties resulting from men being put out of action in the ordinary way of being wounded; and when one country will lose three-quarters of a million men who are actually killed, that means they have been doing some fighting somewhere.

It has been said that Great Britain is not doing her particular share of the work. Well, there are a number of things which it is hard for anybody to account for, and while she may not have done the amount of fighting which is thought to be her share, I think she has done a great amount of organizing, and supplying the various countries who are her allies with ammunition and equip-

ment. At the time when Lord Kitchener first organized his army, the men of his army didn't have any uniforms or rifles, and it was rather strange to see a whole column of men walk down the street with these little dummy rifles—because they were just pieces of wood carved the same length and shape as rifles; but when they went to the front, they were equipped with regular rifles and field equipment. Some wore blue coats, some wore the ordinary civilian clothes, and they looked really like a rabble when you saw them in the street. The punishment meted out to all offenders was that they did their drilling with a two-by-four scantling, ten feet long, and you would see a column of men marching down the street with possibly fifty or sixty of those fellows trying to handle a two-by-four scantling with the same ease that the other fellows handled their dummy rifles. They worked Kitchener's army hard. I think they hold the record for trench digging. They took them to Salisbury Plains, and on that hard, blue clay soil, made them dig trenches, practically doing nothing else, and I think Kitchener's engineers could dig trenches with any detachment in any part of the world. Kitchener's army has done good work, and is doing good work. It is probably more cosmopolitan than any other army except the Colonials. The other section that occupies the same status as your militia, the Territorials, mostly went to India for garrison duty, so as to allow the Imperial troops to get in the fight, themselves. The Canadians, of course, have up to the present time, made a name for themselves, although they had a pretty hard time to convince Lord Kitchener that they were the men to go to the front, owing to the fact that the Canadian troops were mighty good men, but mighty hard on discipline; they do not like discipline, and were difficult to control. I don't know whether I ought to tell these things or not, at the present time, but I will risk it, anyway. I remember one morning at Salisbury Plains, that in one regiment alone, there were over two hundred absentees out of possibly twelve hundred men. These had taken little week-end trips after they were paid, and they considered they were volunteers and did not occupy the same status as the regular Tommy Atkins, and they went, that's all. They did not mind what happened when they came back. One man was forty-two days absent, and on re-

turning, he was given eighteen days field punishment No. 2, which is really hard labor, and considerably worse than the average punishment handed out to anybody else. He skipped off that and was gone about seven or eight days, and they caught him a second time and then they sentenced him to two years in the military jail at Portsmouth,, and he is there yet. Kitchener also said at the time, that if the Canadian troops did not conform to military discipline, he would send them back home. This particular state of affairs I don't think was the fault of the men so much as of the officers; the officers at that time were very ill equipped to take charge of the men, so far as military knowledge and ability to handle men were concerned. Of course, the men of the regular Canadian army understood exactly what military discipline meant, but the men in the Canadian militia didn't have the same idea. To them, it was more or less of a joke, until they actually got into the field.

The Canadians had a particularly hard time of it, inasmuch as the Germans anticipated the fact that they were green troops, and did all they could to break through their lines, and you probably remember at Hill 60, where the Canadians lost four 4.7 guns, it cost them two thousand men to recover the guns, but they got them back again, and they would have gotten the guns if it had taken them all the men in that division, and they are now fairly seasoned fighters, and doing, I think, as good work as the ordinary trained men in the British service.

My own personal experience does not mean anything, other than I was one of the units, and the man, or anybody lower than the rank of brigadier has no opportunity to know what is really going on. From the colonel of the regiment down, the men are just ordered to hold a trench, or to take an opposing trench, to retire, or whatever the maneuver might be, and that is all he really knows about; and, of course, the ordinary Tommy Atkins, or private in the line, has even less chance of knowing what is it all about. He is told to "Stand to," he is told to go to bed, he is told to charge, to retire, or to go to sleep, or to go to the base. You do it, and you have no opportunity of knowing what really goes on except in your immediate front of about two miles. It is really a repetition of going to a trench, staying there and coming

back, or making bayonet charges—incidental work which does not mean anything except as it is made up with the whole, and for the man, himself, it is not the best of jobs, but it has to be done, and somebody has to do it. When you are wounded, of course, they do the best they can to take you to the base dressing station. Some, of course, poor beggars, are three or four days before they are attended to, and some don't get attended to at all. I know that in front of the trenches for quite a while the dead and wounded were piled up three or four feet deep, and there was not a chance in the world to get out any of the wounded; they lay there and they died, and all the best attempts of any man who would give his life to save another were useless, because the bombardment was so severe and so continuous. When a man is wounded, his comrades tie him up as best they can, and the stretcher-bearers come along and take him to the base dressing station. If the medical officer in charge decides that your wounds are sufficiently serious to send you to the base hospital, they send you to the base; otherwise, you stay where you are until you are sufficiently recovered to go back to the front, which, as far as they are concerned, is not very long. If you get sent to the base hospital, which is, of course, quite a few miles away—in this case it was at St. Omer—you are treated with the best consideration, and the best treatment that can be obtained, and I think great merit and praise is due to all the medical men, the nurses and the medical staff, for the work that they are doing. Considering the vast number of casualties they handle, there are very few men who get neglected. Of course, once in a while it happens that a man does not get the service he ought to get. Then, again, if the man's case is so severe that they cannot handle it, they turn him over to the home hospitals, or the Red Cross hospitals, where they have more time and more apparatus to fix the man up. They use every care, and you get every possible treatment that can be given to make you fit, either for civil life or for service—mostly for service, if they get the chance.

Before a man gets discharged from the army, he has to go before a medical board. The medical board adopts the attitude that every man is a possible deserter, and every man is a malingerer,—it does not matter if he goes in on crutches, or on no

feet at all; they simply say: "Well, what is the matter with you?" You proceed to tell them what is the matter, and if they think it is serious enough to send you home, and that you cannot be patched up for the front, they will mercifully allow you to get another examination. Meantime, you hang around the hospital, enjoying yourself as best you can. Finally, you are told that you are to go before the medical board the next morning, which means that you will have to go up and stand around for ten or fifteen hours sometimes, waiting for your turn to be examined, and then, just about the time it comes to your turn, the officers decide to go to lunch, and they go to lunch, and you have to wait until the following day, when the board passes final judgment on the case, and they decide that you really ought to be discharged. From that time on, you have no serious trouble; you are sent to a convalescent home until you are fit to go into civil life. If you desire to go to any part of Great Britain, or if you are a Colonial and wish to return home, the privilege is given you to be discharged either at home or at your point of enlistment. For myself, I decided I preferred to be discharged in Canada, and I received permission to go to Canada to receive my final discharge. We came over on the *Scandinavian*, which was the last boat to see the *Lusitania* before she was torpedoed. She passed us at four o'clock on the day previous, and she was torpedoed twenty-four hours later. There were some forty or fifty of us returning home, some fairly convalescent, some not very well, but it didn't matter very much whether we were well or not,—every man was put to bed in the hospital when he arrived at Quebec, and while we had been eating some rather heavy meals and good meals on board, we received our proper allotment of bread and milk when we landed at the hospital. That bread and milk continued for a week; why, I don't know. We tried our best to get the doctor to give us something to eat, but he decided that bread and milk was a perfectly good diet, and that was all we were going to get. After being in the Quebec hospital for some time, I was told that I could prepare to go to my final point of discharge, which I named as New Orleans, and I received my transportation to New Orleans, and as far as the Government and myself are concerned, we are quits, and I am very glad to say

that I am home, where I intend to stay, and personally, I don't think that I would care to take another shot at the same business.

I would like, gentlemen, to make a suggestion, if I may. It is purely a suggestion, but proved a success in certain regards. In the matter of your preparedness—we had in Great Britain and Canada, in fact, all over the British colonies, a body of men called the Legion of Frontiersmen. These men were, as the name implies, frontiersmen or experts at some particular line of business. Each man was enrolled to enlist for active service when called upon—or rather, when and where called upon, by the British Government; each man provided his own equipment, and each man paid his own expenses. Commands were organized wherever a number of men were got together who were sufficiently interested to form a command, and that command was forwarded to the British War Office, and if it was accepted, all went well; you were told to go ahead. If the War Office decided that the commandant was not sufficiently capable, another man had to be elected. I don't know whether I am in order in making the suggestion, but I think that right here in New Orleans, outside of any other city, you have a vast body of men who are capable, when war is declared, if it should come to that, of being properly trained without the necessity of joining a regular regiment, or even joining your National Guard. To join the militia, as I understand it, even in Great Britain, entails a good many sacrifices of your time and other interests, which you can ill afford to spare. Now, with the Legion, we made it a rule that every man was expected to attend drill, if possible. We left it to him, if his interest was sufficient, he attended drill. We had iron discipline while on parade. While the men were in uniform, the difference between ranking officer and trooper was strictly observed, but after the parade was over, all ceremony was dropped, and everybody was on an equal basis. There was no question of one man being better than another, but naturally, when you are organizing a body of men, you must have order, and if you cannot have order, you do not get the results. We used every endeavor to get the best instructors for our commands. In the Victoria and Vancouver commands, in which I had the honor to command the Victoria unit, we got the men from the Government

posts—we got the lieutenant of the signal corps to come and teach us signalling, and we had the major of artillery to explain to us the practice and principles of modern artillery, and anybody who had anything which could be useful to us in time of war, we made him tell us all he knew about it, and if any of our members was an expert in any particular line—for instance, one was a wireless telegrapher, and we got him to rig up a wireless outfit, and he taught us the use of that. In fact, anything which was of service in military affairs, we trained ourselves in. The Legion of Frontiersmen provided Great Britain with ten thousand men at the front. Those ten thousand men, out of a membership of about fourteen thousand, of which each man was a self-supporting unit, didn't cost the Government a nickel—or a penny, I should say, at any time. They were ten thousand men who were trained and enlisted, and took part in this war.

That is the suggestion, gentlemen, that I wish to make, and I think that if you were to use a modification of it, adapted to your American standards, with your American drills, and with the usual enthusiasm about it, you could take the thing up, and I think you would find that it would well repay you, if it ever came down to a time when America had to go to war. You have vast numbers of men, but I think it is necessary that you should have trained men. The Canadian contingent was seven months in England getting training, when they could have been fighting. A man, unless he has had training, will not be of great use in a contingency of that kind.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Board of Direction, July 10, 1916.

The meeting was called to order with President Young in the chair and Messrs. Dusenbury, Gregory, Klorer, Manley, Olsen and Hogg present.

Minutes of the previous meeting were read and approved.

Ballots for the admission of members were opened. There were 54 formal ballots and 5 informal. The following were elected:

Resident Members—A. F. Barclay, 5670 Rosemary Place, New Orleans; James D. Beck, 2331 Constance street, New Orleans; Lezin A. Beemel, 1510 Arabella street, New Orleans; John Walter Fairlie, 6319 Laurel street, New Orleans; James McC. Fourmy, 2218 Prytania street, New Orleans; Frederic D. King, Jr., 1418 Seventh street, New Orleans; James C. Moore, 2612 Marengo street, New Orleans; Oscar Riess, 1423 Milan street, New Orleans; Gilbert D. Von Phul, 322 Hibernia Building, New Orleans; Charles S. Williamson, Jr., Tulane University, New Orleans.

Non-Resident Member—Jno. de M. Crawford, twelfth floor Q. & C. Building, New Orleans.

Transfer Non-Resident Associate Member to Non-Resident Member—Samuel Wallace Elbersen, Crowley, La.

Resident Associate Members—George J. Glover, 1022 Whitney Bank Building, New Orleans; W. E. Wakefield, 1709 Baronne street, New Orleans.

Resident Junior Member—William F. Eblen, 7822 Green street, New Orleans.

Non-Resident Junior Member—Carl Schneider, Meraux, La.

Transfer Student to Resident Junior Member—Clifford H. Stem, 7933 Poplar street, New Orleans.

The following bills were approved for payment:

Tulane University Press (Printing and Mailing June Proceedings)	\$160.00
Tulane University Press (Printing and Postage)	23.00
Dameron-Pierson Co. (Material for Addressograph)	.89
The Engineering Magazine (Subscription ½ year)	1.50
W. T. Hogg, Secretary (Salary and Incidentals)	34.50
Fabacher's New Rathskeller (Refreshments June Meeting)	7.00

Financial statements of the of the General and Proceeding Funds and the Cash Account were submitted by the Secretary and accepted. The statement showed a balance for the first half 1916 of \$222.44 in the General Fund and \$212.19 in the Proceeding Fund, and cash on hand after paying all bills \$67.86.

A communication from Mr. F. H. Newell was read. Mr. Newell asked that a committee be appointed to coöperate with the Committee on a National Water Law, in the A. S. C. E. It was moved and carried that Messrs. C. W. Okey, A. T. Dusenbury, John Klorer and A. M. Shaw be appointed on this committee with Mr. Okey as chairman.

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Board of Direction, September 11, 1916.

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

Minutes of the previous meeting were read and approved.

The following applications were ordered to ballot:

For Non-Resident Member—O. F. Reiszner, Lecompte, La.

For Resident Junior Member—S. D. Jackson, 533 Baronne street, New Orleans.

For Transfer from Student to Non-Resident Junior Member—Horace M. White, Stamps, Ark.; ordered to ballot, subject to approval of Membership Committee.

To enter our Proceedings under second-class matter, the following resolution was adopted:

Resolved that of the \$2200 annual membership dues paid in the Society, \$300 shall be for a year's subscription to the "Proceedings of the Louisiana Engineering Society."

The question of painting or papering the Library was taken up and after a brief discussion it was moved and carried that the matter be left in the hands of the President.

The resignation of Mr. Edwin T. Russell, effective December 31, 1916, was read and accepted with regret.

The following bills were approved for payment:

Tulane University Press (Printing and Mailing August Proceedings)	\$142.60
Owen Gernon (Binding Magazines, 14 Volumes)	19.00
Tulane University Press (Printing and Postage)	24.25
T. Fitzwilliam Co. (Card Index for Membership)	3.75
W. T. Hogg, Secretary (Salary and Incidentals)	34.40
Electric Railway Journal (Subscription)	3.00

The financial statements of the General and Proceedings Funds were submitted by the Secretary and accepted. The statements showed a balance in the General Fund for the first eight months of 1916 of \$426.53 and in the Proceedings Fund \$361.09. The cash statement showed cash on hand after paying all bills \$524.04.

There being no further business, the meeting adjourned.

W. T. HOGG, Secretary.

Regular Meeting of the Society, September 11, 1916.

The meeting was called to order with President Young in the chair and 37 members and guests present.

Minutes of the previous meeting were read and approved.

Mr. Shaw, chairman of the Library Committee, reported that the cards suggesting new books for the library had started coming in, but no tabulation of books to be purchased would be made until all the cards were in.

The technical exercises of the evening were then held. Mr. Chas. W. Okey read a very interesting paper entitled, "Recent Storm Tides on the Gulf Coast." A lengthy discussion followed, during which Mr. Shaw of Gulfport, Miss., described the work of coast protection that was under construction at Gulfport.

Mr. A. M. Shaw moved that Mr. Okey be tendered a rising vote of thanks for his carefully prepared paper, and Mr. Hobart D. Shaw of Gulfport for his interesting description of the work of coast protection at that place. The motion was seconded and carried.

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

W. T. HOGG, Secretary.

The Proceedings of the Louisiana Engineering Society

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

DOUGLAS ANDERSON, Editor.

The Louisiana Engineering Society is not responsible for any
statement made or opinion expressed in this publication.

Subscription, \$2.00 per annum

Single copy, 35 cents

ADVERTISING RATES

	ONE YEAR	HALF YEAR	ONE ISSUE
Full page	\$50.00	\$28.00	\$10.00
Half-page	28.00	15.00	6.00
Quarter-page	15.00	10.00	4 00
One-eighth page	10.00	6.00	2.00

For the back outside cover add 50 per cent to the above
rates. For the inside covers add 25 per cent to the above
rates.

Address all communications to
Douglas Anderson, Editor, Tulane University,
New Orleans, La.

Entered as second-class matter July 27, 1916, at the Post Office at
New Orleans, Louisiana, under the Act of August 24, 1912.

LOUISIANA ENGINEERING SOCIETY

OFFICERS FOR 1916

President, SAMUEL YOUNG, 1002 Perrin Building.
Vice-President, A. T. DUSENBURY, 236 Baronne Street.
Secretary, W. T. HOGG, Tulane University.
Treasurer, JOHN KLORER, 213 New Court House Bldg.

DIRECTORS.

W. B. GREGORY, Tulane University.
OLE K. OLSEN, 822 Perdido Street.
L. C. DATZ, United Gas & Electric Eng. Corporation,
Birmingham, Ala.
R. S. MANLEY, 301 Q. & C. Building.

STANDING COMMITTEES

On Technical Papers

W. B. Gregory
A. M. Lockett
Chas. W. Okey

On Library

A. M. Shaw
E. H. Coleman
B. S. Nelson

On Publications—Division "A"

Douglas Anderson
J. M. Robert
W. T. Hogg

On Publications—Division "B"

W. H. Williams
A. T. Dusenbury
R. B. Quincy
John Riess
G. A. Seaver

On Membership—Division "A"

Ole K. Olsen
James S. Sharp
G. W. Lawes
H. E. Crump
R. S. Manley
Chas. M. Kerr
L. H. Guerin

On Membership—Division "B"

Alfred Raymond
T. L. Willis

On Employment

H. Kokosky
Chas. J. Hardy

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

All business communications should be addressed to W. T. Hogg, Secretary
P. O. Station 20, New Orleans, La.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. II

DECEMBER, 1916

No. 6

CONTENTS

EDITORIAL NOTES AND COMMENT:	PAGE
Shore Protection Along the Gulf Coast	305
The Address of Colonel Schulz	306
Engineering Problems for College Students.....	307
The Louisiana State Board of Engineering Examiners.....	314
New Members	315
BOOK REVIEWS	316
PAPERS AND DISCUSSIONS:	
Data and Designs for a System of Shore Protection for the Coast	
Line of Harrison County, Miss. <i>By H. D. Shaw</i>	318
The Improvement of the Mouth of the Mississippi River. <i>By Lt.</i>	
<i>Col. E. H. Schulz</i>	329
Discussion	341
Discussion on the Boiler Code of the American Society of Mechan-	
ical Engineers	345
MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.....	350

EDITORIAL NOTES AND COMMENT

Shore Protection Along the Gulf Coast.—The problem of the protection of the shores of the Mississippi Sound and similar localities on Lake Pontchartrain against the erosive action of the waves is one of great interest and importance to the people in this part of the country. Increasing attention has been directed upon this problem in the past few years on account of the severity of several of the recent tropical storms, in which the wave wash and consequent erosion have been so great that they constitute a serious menace to the permanency of location of much of the front properties along the above mentioned shores. The character of the soil is such that it is very susceptible to the erosive action of the water at all times, and when violent storms occur the additional damage and loss

of shore frontage becomes very great. Protection of these shore lines has never been attempted in any comprehensive way, or by the co-operation of the various localities concerned. One of the greatest difficulties in the way is the high cost of construction of any effective means of protection such as a sea-wall of re-inforced concrete, for instance. These localities being residential districts almost exclusively, with the exception of a few of the larger towns, such as Gulfport, the assessed valuation of property is not sufficient to bear the cost of a really adequate system of protection. Individuals have from time to time made efforts to protect their property by means of bulk-heads of different kinds, such as wood piling, reinforced concrete piling and brick walls. None of these have proven really effective.

Elsewhere in this number of the *Proceedings* appears a paper by Mr. H. D. Shaw, City Engineer of Gulfport, Mississippi, in which he proposes a solution of the problem. The merits of Mr. Shaw's plan will have to stand the test of criticism of other engineers who may be in a position to speak with authority upon this subject. It is hoped, therefore, that the paper will bring forth such discussion as the importance of the problem to the people of this community deserves. The Editor will welcome all such discussion for publication in subsequent issues of the journal. We are indebted to Mr. Shaw for the interest he has shown and the work he has done in getting up this paper for publication in the *Proceedings*.

The Address of Colonel Schulz.—On the eve of his departure from New Orleans Col. Schulz, at the invitation of President Young, was kind enough to give the Society some of his valuable time in order to set before us a resume or synopsis of the work which has been done upon the Improvement of the Mouth of the Mississippi River. He has also revised the stenographer's report of his address and given us permission to publish it in this issue of the *Proceedings*. The problem of the Mississippi River in all of its various phases is an ever present one for this community, and one with which a large percentage of the membership of this society is in active touch. Any additional information or data is therefore always of interest and value.

Col. Schulz's work has to do more particularly with the maintenance of the navigable channel of the river, but this portion of the whole problem is very closely connected with the other important aspect of it, protection of the land from overflow.

Following the apparently inexorable rule of the War Department Col. Schulz has been transferred from New Orleans to St. Paul. It is a source of regret to the members of this society that we cannot have him with us longer, for we have all learned to like him for his genial personality and democratic spirit, and to appreciate his great ability and high character as an engineer. And while expressing our regret at the departure of Col. Schulz, we desire at the same time to extend a hearty welcome to Major Julian Sehley, his successor, who comes to this district from Baltimore.

Engineering Problems for College Students.—The firm of A. M. Lockett & Company, through their chief engineer, Mr. H. L. Hutson, proposes to establish in several of the engineering schools of this and the neighboring states of Mississippi and Texas a series of competitions for students in the solution of certain engineering problems. The problem proposed for Tulane University students is set forth herewith in detail, while the letter from Mr. Hutson gives a general statement of the problems for the other institutions. The type of problem as set forth will be of interest not only to the students, but to the mechanical engineering fraternity as well.

It is to be noted that all the problems deal with the increase of the load factor and the consequent increase in economic efficiency of various types of power producing plants. A number of these problems deal with plants of a type more or less peculiar to this Southern country,—i. e. a plant with rather expensive equipment, generating power in comparatively small amounts, and operating for a limited portion of the year. This is merely one phase of the great general problem of mechanical engineering, to which the thought and skill of the best engineers of the country is being devoted, the problem of the economic generation and utilization of power. The steady trend towards the solution of the question is in the line of *unification*,

or the concentration of the power generating apparatus in large single units and in large central stations. Perhaps the time may come when power for some of the purposes dealt with in these problems will be transmitted electrically from the larger centres of population in closer proximity to the centres of these agricultural districts.

The statement of the Tulane problem and the letter from Mr. Hutson follows herewith:

A Competition for Tulane University.

Senior Students.

Find a profitable use for the power equipment of an oil engine driven drainage plant during the time it now stands idle.

The importance of this problem to the people of southern Louisiana is in the fact that there are many million acres of wet lands which must be drained by pumping. The drainage plants only run during or after heavy rains and this running does not usually exceed 500 hours in a year. Because of the low lift against which our local drainage plants operate and this fact of only running a few hours in a year, the fuel cost of draining agricultural land is insignificant, being between 3 cents and 20 cents per acre per year.

On the other hand, the interest on the investment in the pumping plant is a much greater amount, especially so when a crude oil engine is used as the motive power.

There are many reasons why the crude oil engine is the ideal motive power for a drainage plant—the chief advantage being that it may be started and run a few hours at a time without loss of time or fuel, due to getting up steam; banked fires, etc.

These advantages have been sufficient to justify the installation of oil engines even when the interest and depreciation charges were more than sufficient to counteract the saving in fuel over a steam plant when figured on the short time these plants run.

We then have the rather novel situation of an extremely expensive and economical machine which stands idle most of

the time and this idle time is all during good weather when the roads are at their best for hauling and when field work, plowing, threshing, etc., may be done.

The use to which the power should be put, should be one suited for a rural community such as will exist on the lands which are drained by the pumping plant, or the product manufactured should be one which can be profitably shipped and disposed of.

One of the features of the problem is the small amount of power available at any one location.

At the small cost at which this power can be generated, there would be ample use for it if there were 30,000 horsepower or more available as it could then be used for electro-chemical work. Yet, when we get one-tenth of the marsh lands drained, there will be at least 30,000 horsepower installed in these drainage plants.

In order to have a concrete case to figure on we will make the following assumptions:

- (1) A drainage district of 5000 acres located similarly to the Raceland Drainage District No. 4.
- (2) The pumping plant located on a navigable outfall canal connecting with Bayou Lafourche and from it through canals to New Orleans.
- (3) The district to be a new one with pumping plant not yet built and canals not yet dug—so that the machinery can be arranged to allow the engines to drive other equipment when not driving the drainage pumps.
- (4) The plant to consist of two units each driven by 150 H. P. crude oil engine running at 200 R. P. M. and connected by friction clutches to pumps—with belt pulley from which power for other uses may be taken.
- (5) The engine will be capable of developing a brake H. P. on 0.5 lb. of oil at full load; 0.65 lb. of oil at $3/4$ load and 0.7 lb. of oil at half

load. The oil will be assumed to be Mexican crude of 18,000 B. T. U. per lb. to weigh 336 lbs. per barrel and cost \$1.00 per barrel delivered in tanks at the plant. (Its present cost in New Orleans is 80 cts. per bbl.)

- (6) In figuring the cost of power to the proposed industry, the cost of fuel, lubrication, labor and repairs are to be charged against the industry, but interest and depreciation due to obsolescence on the power plant equipment are not to be included as it is assumed that this equipment will be purchased in any event to run the drainage pumps.
- (7) Interest and depreciation on all equipment going into the new industry must be charged against the industry and this must include buildings and foundations and power transmission lines if used.
- (8) The cost of all labor going into the use of the power must be figured, and this must include a selling expense for the product of the industry.
- (9) In every case the study of the use to which this power is put must have the conclusion reduced to the commercial equivalent of dollars and cents; in other words, must answer the question—"Will it pay?"
- (10) Although the object of this competition is to find as many profitable uses as possible for this cheap source of power, it is equally as important to find what uses would not be profitable and should the industry which any contestant select prove upon actual figures to be an unprofitable investment, this need not prevent the industry being made the subject of a thesis, and equal credit will be given for

a report recommending against a specific use as would be given one which recommended in favor of it.

- (11) Should the study of industry show it to be profitable when getting this cheap power figure whether it could grow should it require more power and have to purchase engines at \$90.00 per H. P. installed.

11/20/16.

Prof. D. S. Anderson, Editor Louisiana Engineering Society Journal, Tulane University, City:

Dear Sir:—Our offer of a gold medal to senior students at Tulane is one of several similar offers to Southern engineering schools. The other problems have not been written into definite form but are to be about as follows, subject to changes which may be suggested by the college authorities.

- (1) Louisiana State University and Audubon Sugar School:

“Find a profitable use for the whole or a part of the equipment of a Louisiana sugar house during nine months when it now lies idle.”

The interest and depreciation on the large amount of money invested in sugar houses must now be taken care of by the profits on a run of a few weeks which is a heavy drain on the industry. If sugar beets could be raised in this section, thus extending the sugar making season, this might solve the problem. Another solution might be to electrify the mills as is being done in Cuba and use the electric power during the idle season for driving other manufacturing plants.

- (2) Mississippi A. & M. College:

“Find a profitable use for power generated at a sawmill from exhaust steam without any cost other than interest and depreciation on the investment. Assume 2000 K. W. generated by a plant costing \$30 per K. W. with a useful life of 15 years.”

It is possible at most sawmills to install at comparatively small expense an exhaust steam turbine and condenser which

will generate approximately as much power as the sawmill uses, without increasing the expenses of the mill in any way, as no additional firemen are needed nor are more boilers put under steam. The cost of installation is less than most Hydro-electric developments as no expensive dam is required and the steam turbine unit runs at a higher speed and is therefore less expensive than a water turbine unit.

One of the elements of this problem is the comparatively small amount of power available at each location. Were there 200,000 K. W. it would be used for electro-chemical work, or transmitted to industrial centers. As it is, the 2000 K. W. we have assumed in our problem is exceptional, but we took this as we had cost data on a unit of this size which we installed for the Great Southern Lumber Co.

The power available at any location can be increased by installing additional boilers and burning the waste now sent to the burner or hauling wood now left in the forest but this would complicate the problem and we thought best to make the competition cover the use of exhaust steam only.

(3) Texas A. & M. College:

"Assume that in time of war this country was shut off from the possibility of importing nitrates and that the government decided to build an electric generating plant of 60,000 K. W. to obtain nitrates from the air. If this plant were to be located in Texas and have a useful life of ten years, what type of plant, and what source of power would be the most advisable."

We suggest that different students study the following plants each making an engineering report covering the cost of plant and cost of current per K. W. including depreciation and interest.

- (a) Steam plant located at coal mine.
- (b) Steam plant located at lignite mine.
- (c) Gas producer plant at lignite mine.
- (d) Gas engine plant at gas field.
- (e) Steam plant at gas field.

- (f) Oil engine plant at oil field.
- (g) Steam plant at oil field.
- (h) Hydro-electric plant including dam.
- (i) Hydro-electric plant excluding dam.
- (j) Gas-steam engines with any fuel.
- (k) Any other type of plant.

The importance of this problem is shown by the fact that the government appropriated \$20,000,000, for building a plant for the fixation of atmospheric nitrogen. The government will no doubt build a hydro-electric plant, but were it necessary to build such a plant in time of war—the length of time necessary to complete a water power plant and dam would probably throw the choice of power to a steam plant located near cheap fuel.

It has been stated that a large steam plant of modern equipment could, if located at a coal mine, compete with water power on electro-chemical work.

The advantage of this problem for a student's competition is that the raw material from which the product of the plant is made is air and therefore the location of the plant and choice of power is only a question of cheap power.

- (4) University of Texas:

“Find a profitable use for the off peak load of an electric plant in which the current is generated by an oil engine.”

Assume that the interest and depreciation on generating equipment is taken care of by the regular output of plant and that the only cost of current for the new industry is cost of fuel and a pro-rata of operating expense and repairs.

- (5) Rice Institute:

“Find a use during the idle season for an oil engine of 500 B. H. P. installed in a rice irrigation pumping plant.”

Rice irrigation plants run about three months in the year and are idle the remainder. The loss of interest on the investment was a serious matter when steam plants were used exclusively but will become more important if as seems probable, oil engines are used.

You will note that in selecting these problems, we have had several objects in view. We want to encourage the students to reduce their engineering results to the commercial units of dollars and cents rather than B. T. U's or K. W's. We want to bring out the fact that power can be produced very cheaply in the South. We want to fix the attention of the college students of to-day who will be the engineers of a few years hence on the economic possibilities of the South by having them look around them for uses to which power, and incidentally, their own engineering education, can be put.

Finally, we want to find the best solution of these various problems, as we think in each case, the problem is one which it is important for the engineers, chemists and agriculturalists of this section to solve.

Yours truly,

A. M. LOCKETT & CO., LTD.

H. L. HUTSON.

The Louisiana State Board of Engineering Examiners.—

At a meeting of the Board of Directors of the Society, held October 9, the following list of names was decided upon to be submitted to the Governor from which to make selection to fill the five vacancies on the Board:

I. W. Sylvester, Alexandria, La.

A. M. Shaw, 1001 Hibernia Bldg., New Orleans, La.

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

Donald Derickson, Tulane University, New Orleans, La.

Frank H. Waddill, Tulane-Newcomb Bldg., New Orleans, La.

W. B. Robert, Opelousas, St. Landry Parish, La.

W. H. P. Creighton, Tulane University, New Orleans, La.

Thos. L. Willis, City Hall, New Orleans, La.

J. M. Rhodes, Napoleonville, La.

J. T. Bullen, Shreveport, Caddo Parish, La.

Duncan Buie, Raceland, La.

New Members.—Since the last issue of the Proceedings the following additions and transfers have been made in the membership of the Society:

Non-Resident Member.—O. F. Reiszner, Lecompte, La.

Resident Junior Member.—S. D. Jackson, 533 Baronne St.

Transfer from Student to Non-Resident Junior Member.—
H. M. White. Stamps, Ark.

BOOK REVIEWS.

Contracts, Specifications and Engineering Relations. By DANIEL W. MEAD, Professor of Hydraulic and Sanitary Engineering. University of Wisconsin. Pp. xi+535. McGraw-Hill Book Company, New York, 1916.

This book fills a real need in the field of engineering literature and will prove of exceptional value to the undergraduate who is looking forward to a career in the engineering profession.

The opening chapters are devoted to Engineering Relations and deal at some length with the problems of engineering education, the proper attitude not only towards the men one will work with in a professional way but also with the attitude one should assume towards the broad and deep problems of life.

The importance of language as a tool for the engineer as pointed out by the author and considerable space is given to a thorough exposition of its value. "A knowledge of English, and the ability to express his meaning in clear, concise and convincing language, both oral and written, is an asset of great value to the engineer."

Proper ethical relations of the individual towards others, both in and out of his profession, are pointed out as essentials to success in any sense that is worthy of consideration. Stress is laid on character; integrity, responsibility, resourcefulness and initiative as the attributes that are demanded of the young engineer and that point unflinching to his ultimate success.

Law and legal relations are treated at some length. There are chapters on the origin, nature and development of law, legal relations of technical men, legal rights and responsibilities, agreements and contracts.

Day labor and contract systems are contrasted and after presenting both sides of the question he sums up by quoting from Mr. H. P. Eddy of Boston. The conclusions are general as they are the result of investigating conditions in every city of 30,000 or more inhabitants in the United States.

"While recognizing the abuses of the contract system, Mr. Eddy nevertheless, favored that system on account of the greater abuses of the day-labor system." "In a comparison of eight comparable pipe sewers laid in Boston by day labor and by contract he found the additional cost of work done by day to be from 48 per cent to 220 per cent of the cost of similar work done by contract." Similar figures and conclusions can be drawn from various sources, and while, in some cases, evidence is available to the contrary, such cases are believed to be the exception and not the rule."

Instructions to bidders, contracts, and bonds are given in detail for typical cases. Sample specifications covering a great variety of work, are quoted.

The volume contains 500 pages and will not only be of assistance to the practicing engineer but will be an excellent text for use in colleges and technical schools.

W. B. GREGORY.

PAPERS AND DISCUSSIONS

DATA AND DESIGNS FOR A SYSTEM OF SHORE-PROTECTION FOR THE COAST LINE OF HARRISON COUNTY, MISSISSIPPI.

By.

HOBART D. SHAW,
City Engineer, Gulfport, Miss.

To the Members of the Louisiana Engineering Society:

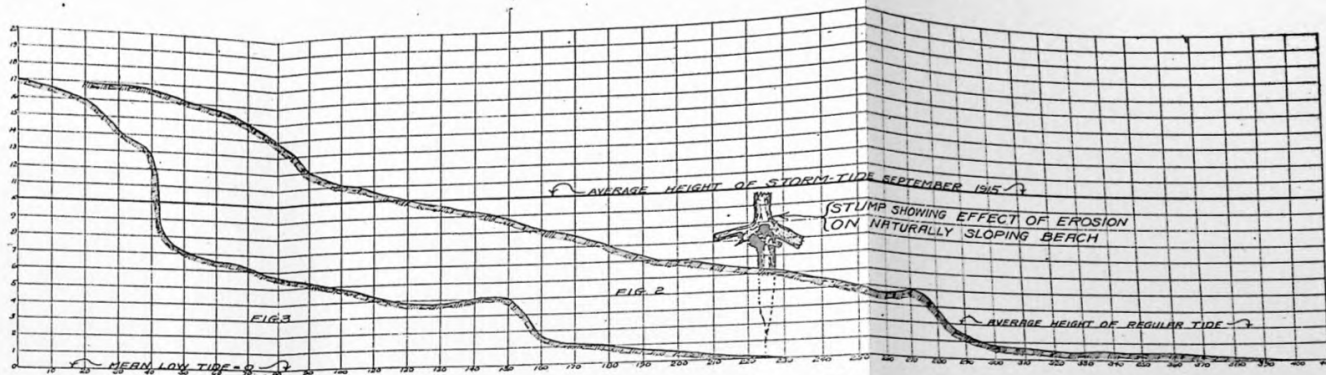
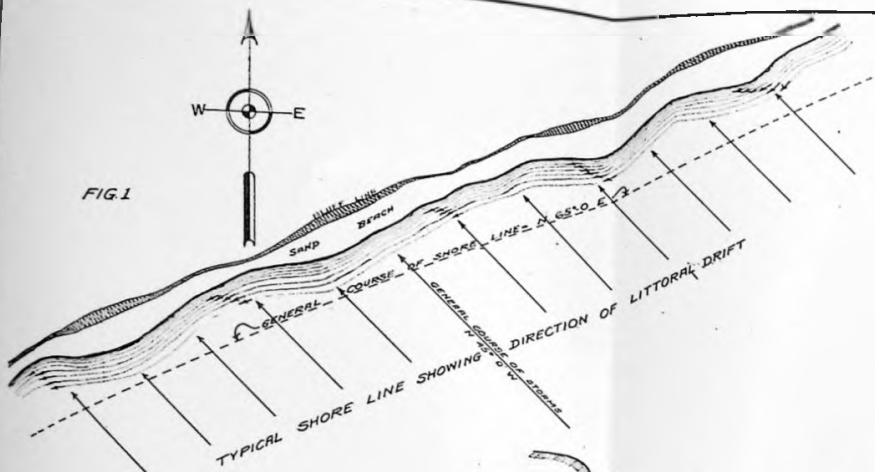
Most gladly do I avail myself of the courtesy extended to me through your Editor in order to present to you a resumé of my investigations and designs for a system of shore-protection for a portion of the Mississippi Coast. To receive such an invitation, I regard as a compliment, and I assure you that I do not lightly esteem it.

It is but proper for me to state that I do not pose as an authority on this branch of engineering; on the other hand, I must admit that this is my first attempt at a solution of the problem, and the ideas advanced and the plans shown are submitted with the firm confidence that you will make due allowances for this fact. If there be merit in my conclusions and the designs based thereon, I can ask no higher praise than a continuance of the cordial interest that you have already manifested in my efforts.

Historical.—The agitation of the question of shore-protection along our coast found its first definite achievement in the passage of a State law in 1912, and this law was modelled after the drainage acts previously enacted; but the two propositions being so widely different in their application it was found that to construct a system of shore protection under this law was more or less impractical, especially as to the method of assessments; hence nothing of an extensive nature was done, except the sole attempt at Bay St. Louis.

The storm of September, 1915, swept over the Gulf of Mexico toward the northward and wrought havoc with the beach front and its adjacent roadway and car line. In addition to this damage many of the most beautiful live oaks and other scenic features were either destroyed or seriously impaired. The resultant conditions awakened public interest to the necessity of pro-

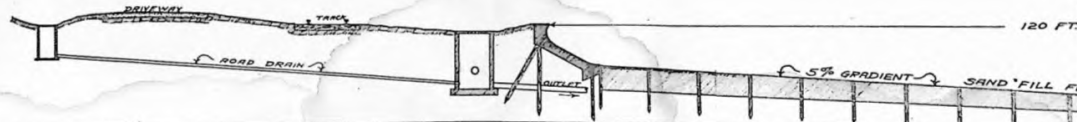
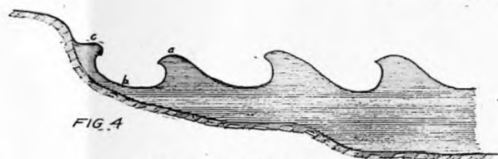
FIG. 1



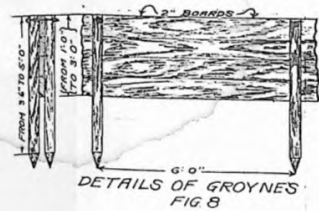
TYPICAL CROSS-SECTIONS OF SHORE

FIG. 4

DIAGRAM OF WAVE-ACTION

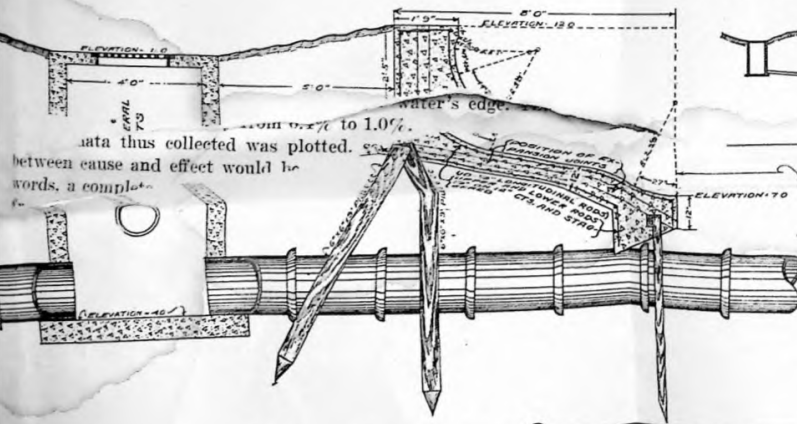


TYPICAL CROSS-SECTION OF COMPLETED WORK
SHOWING GROYNES
FIG. 6



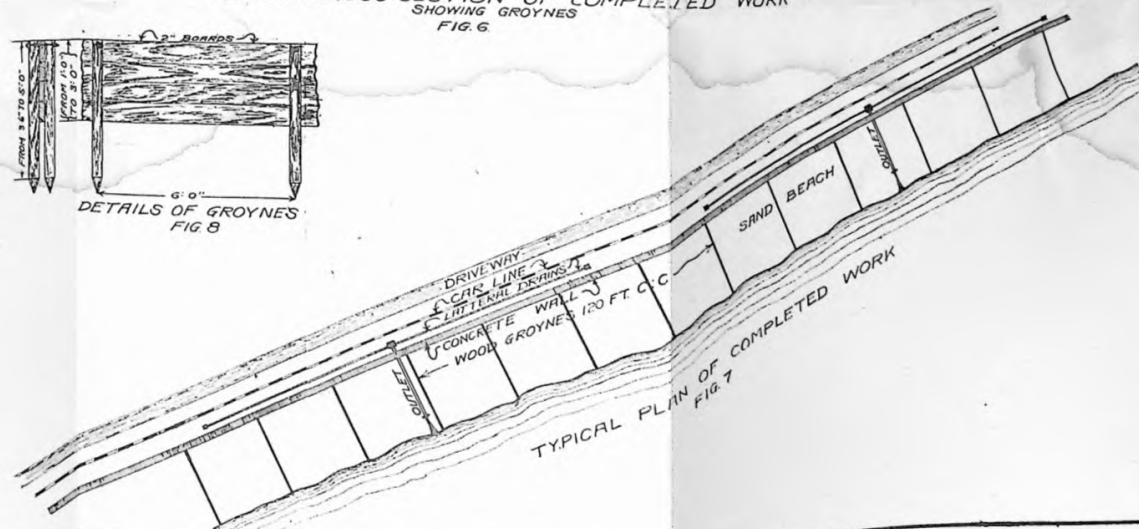
DETAILS OF GROYNES
FIG. 8

DETAILS OF RETAINING WALL AND DRAINAGE SYSTEM
FIG. 5



PLANS FOR PROPOSED SYSTEM OF SHORE PROTECTION HARRISON COUNTY MISSISSIPPI

DESIGNED BY
HOBART D. SHAW
CITY ENGINEER
SULFUR



TYPICAL PLAN OF COMPLETED WORK
FIG. 7

ceeding at once to protect the coast from further encroachments. This activity caused the passage of a more simple and feasible law during the 1916 session of the Legislature. The engineering procedure outlined in this law is fairly good, but by no means ideal. I will not go into a discussion of this law, as it is only indirectly involved in this paper.

The Initial Procedure.—When it became known that the City of Gulfport and the other official bodies were considering the employment of an engineer, or engineers, to make the necessary surveys, plans, etc., I was urged to prepare some kind of plans and present them as a basis on which to rest my application for employment. This I declined to do, as I conceived it to be contrary to the proper engineering practice to prepare any plans until the necessary surveys had been made and all available data collected. I finally convinced the City Commissioners as to the wisdom of this course, with the result that I was employed to undertake the work. In the meantime, various engineers from the uttermost parts of the country came in with ready-made designs that they sought to have adopted; but fortunately these were not seriously considered.

The Survey.—The surveys consisted of a transit base line run at convenient angles along the fore-shore in the customary manner. To this line were "tied in" all the property lines, car track, and other physical structures that might be involved. Along this line I took level readings, and on each side of it I took cross-section readings extending sufficient distances and at necessary intervals to enable me to plot a contour map and comprehensive cross-sections of all the territory affected. At distances of about five hundred feet stadia readings were taken into the water to determine the approximate gradient at which the bottom of the Gulf receded from the shore line, or water's edge. This gradient was found to vary from 0.4% to 1.0%.

The data thus collected was plotted, so that every relation between cause and effect would be partially apparent. In other words, a complete contour map was made which shows contours from 0 to 18 feet, the 0 being the U. S. Government datum.

In addition to the general surveys, I made sufficient tests to determine the angle of repose of the average beach soil in its dry

state and when possessing its normal moisture. In the first case, I found this angle to be $29^{\circ} 26'$ and in the latter $39^{\circ} 48'$. I also determined the capillary attraction of this soil, or what might be more properly termed the resistance offered by the sand medium to the flow of the underground water toward tide level. I found that under average conditions and at a distance of one hundred feet from the water's edge the ground water stands 6.3 feet above the datum plane. The height of this water does not fluctuate with the variations of normal tides. The importance of this data is obvious when it is remembered that the presence of ground-water in the fine sand of which the beach soil is nearly altogether composed, means running quick-sand and hydraulic pressure in case of excavations.

Literature.—At the outset of my work I sought to collect all the available literature pertaining to the general subject of shore-protection; and I succeeded in getting most of that which has been written within the last fifteen years.

It is but proper in this connection that I should mention those writings that I found to be especially beneficial, i. e. *Coast Erosion and Protection*, by Ernest R. Matthews, published by Chas. Griffin & Co., London; *Coast Erosion and Protection on Long Island and New Jersey*, by Gerald O. Case, published in the *Engineering News*, August 19, 1915; *Foreshore Protection by Reinforced Concrete Groins*, *Editorial Engineering News*, April 3, 1913; *The War Against the Waves*, by the late Elmer L. Corthell, published in the *Engineering Record*, April 11, 1914; *The Design of Shore-Protection Works*, by Ralph Bennet, published in the *Engineering News*, July 15, 1915; *The Preservation of Sandy Beaches in the Vicinity of New York City*, by Elliott J. Dent, published in the proceedings of the American Society of Civil Engineers, May, 1916.

The article by Mr. Bennett was found to be of special value. In none of these writings did I find designs that would be applicable to our local problem because of the wide difference in the respective factors involved, yet from them I learned some of the fundamental principles that enter into the general problem regardless of locality.

The Problem.—The damage to which reference has previously been made is caused by the occasional storms that sweep over the Gulf of Mexico toward the land. The regular tides have a variation of only about two feet; and are, therefore, too slight to cause any erosive action worthy of serious consideration.

I have had the opportunity of observing the effects of three of these storms, i. e., September, 1906; September, 1909, and September, 1915. They first manifest themselves along our coast by the gradual rising of the water over the normal heights. This action is the result of forces that I am not prepared to explain, but since it is with the effect and not the cause we are concerned I will pass from this phase of the discussion. The rising of the water produces the characteristic waves as shown in Fig. 4. The crest "a" strikes the bluff and causes a wave lap to "c" and the water falls back to "b"; and since, as before stated, the soil is almost purely sand, the bluff is simply melted down.

Coincident with the rising of the water, gales approach the coast generally from the south-east, as shown on Fig. 1. These gales at first manifest themselves at very moderate velocities, but during the storms enumerated they reached a maximum intensity of over ninety miles an hour, and some observers claim that they reached as high as 110 miles. One of the peculiarities of these winds is that they come in gusts at regular periods, and between these periods there is a protentous tranquility. When the wind reaches a velocity of over sixty miles, it comes in pulsations of terrific force, which added to the energy of the water produces a resultant impact against the shore that is disastrous in its consequences. It is against this combined force that protection is sought.

Littoral Drift.—This brings us to the consideration of what I regard one of the most serious factors involved, and that is the littoral drift caused by the forces above mentioned.

By reference to Fig. 1, it will be seen that the storms strike the general shore line at an oblique angle on the westward.

This angle at times very likely reaches a maximum of 150 degrees; that is when the wind comes from a more easterly course than that indicated.

Now, since the combined force of the wind and water is only partially absorbed by the obstructing shore, or bluff, as the case may be, and by the resultant rebound, it is evident that the direction of this force must be changed. The change thus produced creates a current along the shore line toward the westward. The wave-action, to which reference has already been made, having dislodged varying quantities of material from the fore-shore and the bluff, and the water having this material in suspense, the littoral current, by virtue of its momentum carries this material westward until this current is checked by some obstruction such as a promontory or shoal. When the momentum of the littoral current is checked by reason of suddenly having to change its course it necessarily causes a deposit of the suspended material at that point.

This process is generally spoken of as littoral drift, which is the resultant of two concurrent forces, i. e. the combined force of the wind and water and the reaction of the shore. The operation of this process is shown by the indisputable testimony left in the wake of the several storms, since by it much of the valuable frontage has been swept away only to be deposited at other places, which in turn will be carried further on by the next storm.

Thus, cycle by cycle this phenomenon must continue as it has continued through past Geological ages until something is done to prevent it. This then is the serious question that now engages us.

Erosion and Accretion.—The nature and extent of the process of erosion has already been set forth with sufficient clearness for the purposes of this discussion; but the subject of accretion, or rather the absence of it, is worthy of some mention. It has been a very general belief among the residents of the coast that the action of every storm and even some of the lesser tides results in the bringing in of varying quantities of sand from the bottom of the Gulf, but I am convinced that such is not the case. I am led to this conclusion by reason of the slight gradient

at which the bottom of the Gulf slopes from the water's edge. To me it is evident that the passage of the water over this slope is not offered sufficient resistance to dislodge any material of consequence. I am persuaded, furthermore, that what has generally been regarded here as accretion is simply the littoral drift. I will make use of this conclusion under the discussion of design.

The Sloping Beach.—Is is a very popular idea along the coast that the solution of the shore-protection problem can be solved by simply sloping the beach, or foreshore, from the datum plane to some arbitrary elevation at a gradient of approximately six per cent. In fact, some engineers have been found who favor this scheme. It was even my own impression at the outset that this principle was correct, and I very reluctantly abandoned it. I now take the position that sloping the foreshore at any gradient, however slight, and the thorough sodding of the surface will afford only temporary protection; and the ultimate outcome would not justify the expenditure of the money required to construct it. If we could construct such a slope with its upper and lower edges parallel, so that we would have an inclined plane without recesses or protuberances, so that attacking forces would strike every point at equal angles and with equal impact, then we might reasonably expect nature to recognize the exactness of our work and leave it unmolested. Since such a condition is not possible under existing circumstances, it is useless to consider it seriously.

To construct a sloping beach type surfaced with natural material, such as ordinary sand or silt on an inclined plane, as generated by the moving of a straight line along a decidedly irregular course, which is the plan now in the public mind, there would necessarily result a series of convolutions in the surface, and with this surface composed of erosive material, such as named, it appears to me to be only a question of the number of storms and the intensities thereof to bring about conditions similar to those now confronting us.

The effect of erosion on a naturally sloping beach is shown by Fig. 3. This is not an imaginary diagram, but is an actual illustration of conditions as they exist in many places. In one place

that I checked up, I found that a stump, from around which the earth had been eroded, as indicated, is now at the water's edge, but when the original Government land surveys were made, this tree was over 275 feet from the water. Thus, in a period of ninety years, the shore line at this point has been gradually washed; and as this particular place is perhaps the most gradual natural slope along the coast, I am constrained to believe that its incontrovertible lesson should be heeded.

That there is some inherent virtue in sloping the foreshore, I am fully convinced, provided that this slope can be maintained at some given and suitable gradient; and with the fact before me, I propose to make use of the principle in a manner hereinafter shown.

Designing the System.—With the foregoing data and conclusions in mind, I set about to find some method that would afford the necessary protection. In this procedure I was confined within two arbitrary limits: First, the evident fact that the value of the property to be protected would permit of an expenditure of only approximately ten dollars per lineal foot, and, second, the area on which the proposed protection must be located in order to keep within the first limit. By reason of these limits I was compelled, as all engineers frequently are, to pursue the synthetic method in arriving at the designs; that is, having the costs fixed, I had to work backwards to the method.

I must also admit that being thus handicapped, I was at first chiefly concerned in getting a system that would "fit;" and afterwards devise the factors of safety.

The results of my efforts in this can be more clearly seen from the drawings, which are self-explanatory, but I will point out some of the main features under their respective heads.

Groynes.—The use of groynes is perhaps the most generally used method of shore protection known; and the designs and arrangements of the groynes is a science within itself. For a more extended treatise on this subject, I would recommend the study of the literature before mentioned. For our purpose, groynes of very simple design appeared to be sufficient; and in arriving at the details of construction and arrangement I was governed by the following factors: First, as indicated by Figures

2 and 3, it is seen that the regular tides produce a shoulder along the edge of the water varying in height from three to four feet above mean low tide, or the datum plane; and as this shoulder appears to remain intact under normal conditions, and is even found to exist after the storms, I concluded that the water does not assume any aggressive action until after the elevation of four feet is passed; second, the examination of the contour map before described, together with the cross-sections of the shore plainly shows that the storms have a tendency to leave a foreshore on a gradient between five and six per cent, provided that the littoral drift does not counteract this tendency. I believe, therefore, that it would be a feasible scheme to construct a slope on the first named gradient if the topographic conditions would permit, and secure the maintenance of this slope by the use of groynes. In order to do this, however, a vast amount of filling would be required, as is shown by the cross-sections; and the cost of this filling would exceed the possible expenditure. It must be remembered, too, that we cannot do as is done in other sections, that is; construct a system of groynes and depend on the accretion to fill the spaces between them, because, as before stated, there is no accretion worthy of notice. Hence, whatever space there may be between the tops of the groynes and the natural surface must be filled at the outset; and when so filled the position of the groynes should offer sufficient resistance to the littoral action to maintain the surface at the desired plane. The spacing of the groynes was done in accordance with a "rule of thumb" which has apparently been evolved from long practice rather than from any particular law of mechanics. This rule is: make the spaces between the groynes equal to their length. It has been found to be satisfactory, and is therefore generally used.

Retaining Wall.—Inasmuch as it would be too expensive and otherwise impractical to construct a slope with the necessary groynes to maintain it to the required elevation, I found that a retaining wall was the most adaptable method of overcoming this obstacle. The wall as designed is to act both as a retaining wall for the earth behind the vertical section thereof and also as a slab to protect the upper portion of the foreshore

from the force of the wave impact and littoral erosion. It will be observed that the square piles will serve, under normal conditions, as anchors, and in case of any washout from the rear they will act as supporting piles. The sheet piling will act also as a support as well as serving to prevent any possible undermining from the front.

This wall, were it deprived of the support of the soil by having this soil removed underneath for, say, two feet, would carry three hundred pounds per square foot, and in addition thereto would withstand an impact of three hundred pounds, making a total of six hundred pounds. When it is remembered that it is hardly possible that the earth fill will be taken from beneath the slab, if it is seen that the strength of wall is increased by practically the resisting power of this soil. It is, therefore, reasonable to assume that this wall is sufficient to meet the demands that will be made upon it.

Drainage.—The importance of the drainage in connection with the problem of shore protection can hardly be overestimated; yet it has been practically ignored by some of the engineers who have been working at the proposition. To me it appears that there is almost as much danger from the rear as in the front of any system of protection, and for this reason: During the primeval conditions nature provided sufficient outlets to the Gulf to dispose of the rainfall by devious courses allowable by the trees, undergrowth and other various forms of vegetation. The final run-off of the rainfall was then necessarily a slow process, but when the lands were cleared, roads laid out, and drainage ditches cut, the original shore outlets become correspondingly congested during or immediately after every severe rain. The reason for this is obvious.

In order to relieve the proposed system from the dangerous elements attending the congestion mentioned, I have provided a complete series of outlets of varying dimensions suitable to their respective localities. In connection with these outlets, I contemplate lateral drain pipes to collect the water and convey it to the outlets. The exact details of the drainage system cannot be fully set forth without going into a tedious description, and since these things are only pertinent to particular cases, I will

not consume time and space further concerning them. I think the drawings will indicate with sufficient clearness the general principles used.

Grasses.—There is no doubt that some variety of grass that will flourish on the sandy soil would afford some protection to the upper part of the slope, more in the way of keeping the surface uniform under ordinary conditions, and thus render it less liable to attack by the littoral action. A thorough treatise on this matter is given in the Year Book of the U. S. Department of Agriculture, issued in the year, 1898, pages 405 to 420.

Permanence of the System.—While I have entire confidence in the efficiency of the proposed system of protection, and while I have studied the whole situation with every care and with all the ability at my command; yet I realize that man has never built an absolutely enduring structure, and so we can only venture forward with that assurance afforded by the light before us. I have made it known to the Commissioners by whom I am employed that they might expect some minor damages to occur from time to time; and if some disaster greater than we have heretofore known should descend upon us, there might be consequences concerning the extent of which we can only speculate.

It is my firm conviction, however, that what is herein proposed will combat any storm of the same severity of any of which we have record; and that it will meet the requirement to a degree that will fully justify the expenditure.

Mr. Coleman.—I would indeed feel ungrateful and also guilty of a breach of professional ethics were I to fail, or otherwise neglect, to acknowledge the assistance rendered me by your worthy Ex-President, Mr. J. F. Coleman, Mem. Am. Soc. C. E. His connection with the matter was the result of his being called in by the City Commissioners to analyze and review the data and plans that I had prepared. Mr. Coleman was retained as Consulting Engineer, and as such he went carefully over the work and the ground. In his report on my plans, etc., he made some valuable suggestions, and incorporated some changes in the details of construction that are unquestionably important. All of these suggestions and details have been accepted gladly. The

general scheme was approved by Mr. Coleman as being probably the best that could be devised for the money in sight.

Other Data Needed.—It will very likely occur to those who read the foregoing that there are some important data not given. This I must admit, but its absence is due to my inability to obtain it.

The action of the storms that visit this coast ought to be made a special study by the proper department of the national government. Data should be collected showing the chief characteristics of the unusual tide movements, such as the force of the impact, the nature and extent of littoral currents, and other factors that would suggest themselves in the course of the procedure. It would be manifestly impossible for one of my station and resources to make an attempt in this direction. Hence, I hope that whatever is found to be lacking in this discussion will not be attributed to my failing to recognize its importance, but rather to circumstances beyond my control.

Conclusion.—While the work done and the responsibility incident thereto has proved a source of nervous strain, and while the ignorant and the selfish have been unstinting in their criticism, causing me some anguish of spirit, yet from it I have gained a broader view, a deeper consciousness of my own limitations, and withal a stronger conviction that a vast and unexplored field of endeavor lies yet before us.

Should the system finally be constructed, the joy of fruition will not, I assure you, exceed that which I hope to gain from a more intimate and extended acquaintance with your sterling membership.

THE IMPROVEMENT OF THE MOUTH OF THE MISSISSIPPI RIVER.

By
LIEUTENANT-COLONEL E. H. SCHULZ,
Corps of Engineers.

An Address Delivered Before the Society, October 9, 1916.

Mr. President and Gentlemen: Mr. Young came to me the other day and asked me to give you something on the subject of the Passes, at the mouth of the Mississippi, or on other work connected with the Engineer office, and as I am about to go away and must transfer my work to my successor, Major Schley, who is present, I did not have time to prepare anything special. I have written a paper recently on the Improvement of the Mouth of the River, but it is rather long; but I will give you a synopsis of it to-night, and, later on, when it becomes public, in the Professional Memoirs, it will be available to anyone who cares to read it in detail.

What I shall say to-night is simply from memory and from a few notes which I have prepared. I notice here some of the men connected with the Government, who have been on the work at Southwest Pass, or South Pass, and if I make any errors, I hope they will be temporarily overlooked, because they know the work better than I do.

As you know, you are situated here about 114 miles above the Gulf, via the Mississippi River. You will notice New Orleans is some distance above the point where the Passes separate (indicating on map.) That point is called the Head of the Passes, and the three mouths are called Pass a L'Outre, South Pass, and Southwest Pass. South and Southwest Passes are under improvement by the United States at the present time.

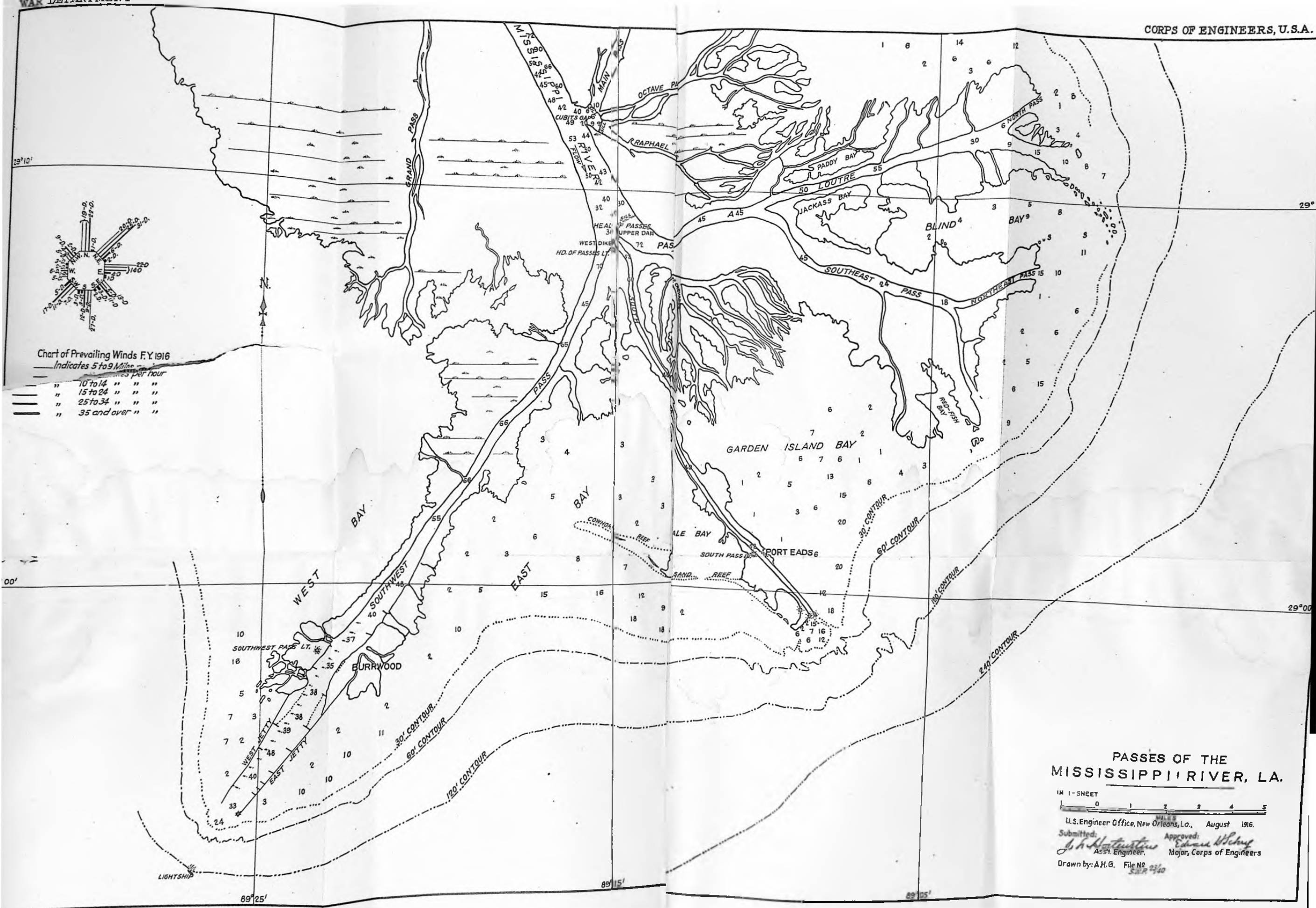
Taking the Mississippi River as a whole, we have a watershed of about 1,240,000 squares miles, which takes about 41 per cent of the entire country. One of its tributaries, the Missouri, has a watershed of about 527,000 square miles, or 43 per cent of the entire area of the Mississippi Valley. The discharge of this river, as you know, was the greatest in 1912, and amounted at

Carrollton to about 1,300,000 cubic feet per second. The discharge at low water is about 100,000 cubic feet per second. I think at this time it is a little less, as we have a very low river now.

The distance from New Orleans to the head of the Passes is 941½ miles; by way of South Pass, it is 1081½ miles, and by way of Southwest Pass, it is 114. The Mississippi is a very long river and some of the distances to interior points are very great. Pittsburg is over 1900 miles from the Head of the Passes; St. Paul is over 1800, and Fort Benton, on the Missouri, is about 3500 miles distant. The distances from the mouth of the river to foreign ports are: Hamburg 5600 miles; Liverpool 5100; the Panama Canal over 1500; and New York 1800.

There are several outlets of the Mississippi River besides the three Passes already mentioned. The one furthest up is known as the Old River, which connects the Red River and the Mississippi River with the Atchafalaya system. This is the particular outlet upon which there have been a good many arguments in recent years, whether it should be kept open, or closed, or more opened. The next outlet, coming down stream, was the Plaquemine, which was closed by a dam in 1867. Later on, in 1900 to 1908, a lock was built, which is now in operation. Of course, very little of the discharge of the river goes through the Plaquemine now—only that proportion caused by lockages. When the lock was built, there was something like 32 feet allowed for the difference between high and low water between the Mississippi River and Plaquemine Bayou, but the flood of 1912 showed that the gate should have been higher, and we placed a steel superstructure about 4 feet high on the gate, to take care of any extra floods. At this particular point, the river is very carefully revetted and taken care of by Major Caples' office, because, if any big cave should take place there, it would seriously affect the lock and possibly stop traffic.

Coming down the river further, we have, next, Bayou Lafourche, which has also been the subject of much discussion. This bayou was closed in 1902, at which time the Levee Boards agreed to put a lock in it some day. The lock is still forth-



PASSES OF THE MISSISSIPPI RIVER, LA.

IN 1-SHEET
0 1 2 3 4 5

U.S. Engineer Office, New Orleans, La., August 1916.

Submitted: *J. H. Hester* Approved: *Edmund H. Schuy*
Asst. Engineer. Major, Corps of Engineers

Drawn by: A.H.G. File No. 2460

coming, but the Engineer Department is making a survey, with a view to placing the locks based on coöperation if the Levee Boards, to pay a portion of the cost.

After we pass the Lafourche, we have no outlet until we come to Grand Pass, or the Jump, which is a small bayou running off to the west, and just above Head of Passes. This outlet is open, and carries about 1 per cent of the flow of the Mississippi River.

Coming down a little further, we come to Cubit's Gap, which takes about 6 per cent of the river.

Grand Pass and Cubit's Gap both have sills across them to reduce the flow, and to maintain the equilibrium at the Head of the Passes.

We then come to the head of the Passes, proper, with depths of 30 to 35 feet. The original depth of water over the bars at mouths of the Passes was about 9 feet, so you can see what a tremendous handicap shipping interests were confronted with in the old days, in getting commerce to the port. I understand that vessels used to lie beyond the bar for days, waiting for tides or wind or an extra high water to help them through. It was in 1836 or 1837 that the United States took the first action toward doing some work there. This consisted of the expenditure of about two hundred and eighty-five thousand dollars, in running a bucket drag through Southwest Pass, trying to stir up the bottom so that the sediment would be raised and get into the current, and then flow off. This was only a partial success.

In 1852, Congress appropriated some more funds, and also appointed a Board to investigate the matter. The Board recommended four different methods, one of which was stirring, one dredging, one revetting and jettying, and if these failed, they recommended a canal. Nothing was undertaken except the stirring of the bottom, and that was only partially successful.

In 1856, another Board was appointed, and \$300,000 was spent and some work done by stirring the bottom, and the construction of a small jetty along the west side of South Pass. The jetty was destroyed, and the plan failed.

About that time, the war came along, and of course, the Government appropriations ceased, and nothing was done again

until 1867, when another couple of hundred thousand dollars was appropriated and a powerful dredge was built to stir up the bottom and deflect the current, but the river was soon in about the original condition, 10 to 18 feet of water.

About this time—in 1871—Congress took a serious interest in the matter, and appointed a Board, to determine whether there was some way of constructing a canal from the Mississippi River to Breton Sound. This Board reported in favor of the canal, which was to be about 200 feet wide and 27 feet deep, with a lock 60 feet wide by 500 feet long and 25 feet over the sill. The minority report, however, favored the jetties, even with the limited experience they then had.

Another Board was appointed in 1875, which was, also, divided in its views, most of them recommending the jetties, but one of the members recommending the canal. About this time, as you know, Mr. Eads submitted his proposition to Congress, and he concurred with the majority report, in that he held that he could jetty the Passes. He wanted something like ten million dollars, I believe, for Southwest Pass, and eight millions for South Pass, including twenty years' maintenance. Congress finally made an agreement to give him South Pass. The work was completed in 1879, and the maintenance period ended in 1901, after which the United States took charge.

The project under which Mr. Eads was working was a central thread of 30 feet depth, with an actual channel of 26 feet depth and 200 feet width, and he obtained this and maintained it for twenty years under those conditions. But the commercial interests of this city were not satisfied with a channel of such restricted dimensions—the Pass, itself, was not over 500 feet wide; and the deep channel not over 200 feet wide,—so about 1898 or 1899, the Commercial interests petitioned Congress to look into the matter of opening Southwest Pass, and that is the pass upon which most of the improvement has been conducted during the past years.

A board was appointed in 1898, and they adopted a plan and recommended a channel a thousand feet wide and 35 feet deep through this Pass.

They recommended parallel jetties 2400 feet apart, built of mattresses 3 feet thick and 150 to 200 feet wide, with each succeeding tier narrower, until the surface of the water was reached. The whole matting was then to be capped with large stones, or concrete, from 2 to 4 feet above mean high water. The estimated cost was thirteen million dollars, and as it was considered too great, another board was appointed in 1899, in compliance with Act of Congress, to investigate and report whether a project of lesser cost could be adopted. This Board recommended a modification of the 1898 Board plan, in that instead of the jetties being parallel, they first splayed apart and then came together, and crossed the bar at a distance of about 3000 feet apart. The object of this plan was to utilize the area in these angles by deposits from the dredged channel. It was expected that the banks would be formed and a channel of about 2400 feet width created. The estimated cost was \$6,000,000.

In carrying out the second Board's project, some modifications were made in that the jetties, instead of having the angular plan, were simply converging, starting 6000 feet apart near Burrwood, and extending out to the 20 ft. contour beyond the bar, and about 3000 ft. apart at this point. On this basis the work has been constructed.

To take up the matter of the proper development of the Passes, required a study of many conditions. The equilibrium of the water, which divides at the head of the Passes, must be carefully considered. If any contraction is made in any pass, it necessarily chokes that channel temporarily and raises the head of water, and that head causes more water to flow down the other two channels, and temporarily really less down the one which is to be improved. So that if any contraction is to be made, dredging should be carried on at the same time so as to keep a uniform cross-section. Then, there are considerations of tides, and sediment brought down the stream, deposits, mud lumps, currents, winds and wave action.

The cross-sections of the various Passes have increased in the last fifteen years—South Pass from 16,000 square feet to 23,000; Southwest Pass has remained nearly constant, with a cross-section of 75,000 square feet, and Pass a Loutre has been

reduced from 82,000 to 78,000,—so that the percentage of increase for South Pass has been from 8.6 to 14 per cent, or nearly 60 per cent of itself. In other words, South Pass, in the last fifteen years, has gotten larger by 60 per cent of itself, which is a good deal for a pass of that size.

In the last two or three years, especially in high floods, we have had a great deal of erosion in South Pass. There has been more water going out, and more deposit at the mouth of the Passes. The erosion has reached such an extent that at the head of the Passes we are now placing a sill consisting of about sixty mattresses, 100 feet by 200 feet—and by the way, Major Caples' office is doing this work, as he has the facilities, and the work is similar to the revetment work done along the main river. The proposed work includes protecting the points of land between Pass a Loutre and South Pass, and between South Pass and Southwest Pass. These are being placed now, and will be an interesting sight to anyone who can visit the locality in the next two weeks. If we don't get them in before the water begins to rise, there will be some difficulty in placing them. While the mattresses are being placed across South Pass, the boats may temporarily have to use Southwest Pass.

The first book of any importance, and really a wonderful book, on the Mississippi River, is an investigation and report made by Humphreys and Abbot, of the Corps of Engineers, in 1856-60. They stated the total discharge of the Mississippi River at the time, at about nineteen thousand five hundred billion cubic feet a year, amounting to a mean discharge of about seven hundred thousand second-feet. The sediment brought down was something like 443 million tons a year, and that was sufficient to build a mound one mile square and about 260 feet high. And that is a sample of the mud that is coming down this river every year. During the high water last spring, it was estimated that about two million yards of sediment per day was carried through Southwest Pass alone. Now, you can imagine that this sediment has to be taken care of in some way and gotten away from the mouth of the Pass, or it just simply chokes itself and forms a bar and keeps growing.

Velocity measurements taken at Burrwood this spring—about two miles above that point—showed a mean velocity of 3.6 to 3.9 feet per second—a mean discharge of about 322,000 second feet and maximum velocity of about 5.87 ft. per second. The stream at this point was 2800 feet wide and had a depth of 45 feet. The velocity in the Passes generally is a little greater in South Pass than it is in Southwest Pass, especially near the bottom, which partly accounts for the better water we have in South Pass. Of course, it is a narrower channel, and for the same depth it has a better hydraulic radius, conveys less sediment and keeps itself open better. It is however narrower than the commerce of this city demands.

We are having a good deal of difficulty at the mouth of South Pass. While the jetty has not been extended since its construction in 1879, the channel moves off about 38 degrees to the eastward, and consequently all vessels going in or out this Pass have to make a sharp turn in that 500-foot channel. Right at the mouth a bar has been forming, and when there are easterly winds blowing, the ships have some difficulty and at times get aground, but it is never very serious, because of the mud bottom.

Some investigation has been made this year as to the currents outside in the Gulf. There has been a great deal of discussion as to which pass is in the better position with respect to what they call the littoral current, that is, the offshore current, and it has been very hard to decide, notwithstanding a good number of observations have been taken. The currents depend so much on the wind and on the tide that they may be moving to the westward one day and to the eastward the next day. Easterly winds, however, preponderate and consequently the flow of the water is slightly more to the westward. Now, the Southwest Pass, itself, is on this line, so that a westerly current may act on this pass probably as favorably as it does on South Pass. All we know is that the sediment is deposited slightly more to the west than it is to the east, and especially at South Pass. At Southwest Pass, it is more or less symmetrical.

The ordinary tides at the mouth of the river have a range of about 16 inches. With the changes due to strong winds, how-

ever, it frequently reaches 3 feet. Storm tides are 5 to 6 feet, and in the storm of September 29, last year, we had a height of 5.76 feet above mean gulf. That practically covered the whole ground at Burrwood, where the engineer station is located.

Some investigations were made on the specific gravity and the salinity of the water at the Passes. We found that during high water, the fresh water extends out over the salt water a considerable distance. In fact, there is a regular plane between the salt and fresh water. If you take a sounding right off the mouth of the river, you have to go pretty deep to get salt water, and a couple of miles further out the depth to salt water is less, and at some distance further the plane reaches the surface of the gulf. On the other hand, when the river is low, the salt water moves up into the Passes, not only the under water, but the top water, so that now boats are coming up as far as Quarantine to get fresh water for boiler uses.

Regarding sediment, there has been a good deal of investigation as to just what causes these bars and how they maintain themselves. In high water the proportion of sediment is about seven ten-thousandths of the volume of water. At low water, the water is fairly clear. Sometimes it is as high as one to four-thousandths. A good deal of the fine sediment moves out a good distance in the Gulf, but some of it is deposited within the first five or six miles of the mouth of the jetties. The very fine material moves out further than the heavy material. The heavier bar material is really near the bottom, and is probably rolled along. While I call this heavy, it is really very fine sand. It is too fine for any commercial use, but the finer material, the real fine sand, is even finer than that, and is mixed with silt and clay. About 60 per cent of all the material is this fine sand, and about 38 to 40 per cent is silt and mud. Now, this fine material is deposited in advance of the pass, and the heavier material moves out and forms a bar over the finer material, so that whenever we are dredging, we come to coarse material first, and underneath, we come to the finer material. This deposit has averaged, in front of Southwest Pass, about two feet a year, that is, taking a radius of five miles in front of the jetties, the fill is going on all the time and, of course, the channel has to be main-

tained through it. South Pass, taking roughly about one-third of the sediment, makes a proportionate fill of about .67 foot per year. The Southwest Pass bar advances about 290 feet a year, and South Pass about 53.

In order to create the Southwest Pass channel and to help maintain it, dredging has been necessary, and for this purpose, the United States has had several suction dredges, both pipe line and hopper. The two dredges now at work, are of the hopper type. One is a Fruhling suction dredge, which really has a catamaran stern, and suction head in the shape of a hoe, which is dropped down on the bed of the stream at an angle of about 45 degrees, and sucks the material through it and deposits it in the hoppers. This dredge is especially valuable in mud and in places where she can stay at one place and dredge, because the hoe practically anchors her and she hangs there until she dredges everything within reach. The other dredge is a type of side-suction, and has to have steerageway to move.

The two dredges take out nearly four million yards a year, and frequently we have to hire a third dredge to keep the channel open. Last spring, during the extreme high water, an extra effort was made and in ten days the dredges took out 182,000 yards, and in one month, 470,000 yards, but nevertheless, between March and June, the deposit exceeded the excavation by about 220,000 cubic yards. You can see for yourselves, it is evident that if two million yards of material passes out through the jetties in a day during those extreme high waters, when the current is rising, no amount of dredging would keep it away, because as fast as you dredge it, the sediment drops in and fills the pocket that is being dredged. About \$3,700,000 have been expended on dredging since the work began. The total amount removed in Southwest Pass since the work was begun is over thirty-two million yards.

At South Pass, we have removed about six million cubic yards since that work was begun, of which 900,000 was taken out last January to July. This latter material was all outside of the jetties, and it is the first time any serious trouble has occurred in South Pass for some time. It is not easy to account for it, except for the fact that the jetties not having been ex-

tended, the whole foreshore is gradually building up, and it is simply more difficult for the river to keep its channel through the shoal.

Now we come to Southwest Pass jetties more in detail, as that is the Pass, now under construction and the one in which New Orleans is now interested. Before entering on this subject, I would like to tell a little about the commerce of New Orleans. In 1910, the total imports and exports were 4,000,000 tons. In 1915, they had increased to 6,500,000 tons, with a value of about \$370,000,000.00. The gain was about 41 per cent in value and about 66 per cent in tonnage in five years. The foreign commerce in 1914, according to the records of the Department of Commerce, was for New York, \$1,900,000,000.00; for New Orleans, \$283,000,000.00; for Galveston, \$268,00,000.00; Massachusetts, \$225,000,000.00; Philadelphia, \$161,000,000.00; Baltimore, \$144,000,000.00, and San Francisco, \$130,000,000.00. This placed New Orleans second, and since then, its relative increase has been greater than some of the other ports, as you know. The total clearances and arrivals at New Orleans during 1915 were:

Foreign	2,682
Domestic	1,275
Total	3,957

The net registered tonnage was over 8,000,000.

The biggest foreign exports are wheat, about 900,000 tons; cotton and cotton manufactures 400,000; flour 200,000. The total domestic shipments are also very heavy, mostly going to New York, New England, and Texas.

In order to keep Southwest Pass open, tremendous efforts must be made at times, because, when these floods come, the sediment is dropped, shoals form, and telegrams and telephone messages come in from the various lines asking for deep water. The depth at New Orleans at Canal street is 120 to 150 feet, and then decreases down the river, reaching a depth of about 50 feet at Head of Passes, and then right at the Head to something like 30 or 35 feet. But that is not serious because it can be kept open there. Then we come to the mouth of the Passes and out over

the bar, where it is difficult to keep over 30 feet. This is the condition in the last seven miles of Southwest Pass. Here is Burwood, which is practically a Government village, having about 50 houses, something like three or four hundred people (employees and their families), a schoolhouse and sometimes church services, a post office and country store. The employees come to town, to New Orleans occasionally. This deep water (35 feet and greater) is shown on the map. Here the channel is about 2400 feet wide, and we have the width and depth. Where it begins to widen, we have temporary shoals. The river is in unusually good condition at the Pass now, because it is low water, and having dredged it out this spring, there is not much sediment coming down. As you approach the end of the jetties, the depth gets less and less, and finally, just as you cross the bar, in the first 2000 feet, we have 26 to 28 feet at present. We did have as much as 30 feet or 31 feet two years ago, but the advance of the bar has taken that away, and the present plan is to extend the jetties out to the bar and thus renew that depth. This has been approved and will be shortly under way.

The work at Southwest Pass has consisted in the construction of two jetties, starting about 6000 feet apart and being about 21,000 feet long, and extending so that they converged and finally reached a distance apart of about 3000 feet. The reason they were placed at this distance instead of 2400 feet apart, was to reduce the cost at that time. The present plan is to build inner jetties or revetments 2400 feet apart, so that the same width will be obtained all the way through, and necessarily it ought to produce practically a uniform depth of channel with the same discharge.

That is the present report which was recently submitted and which it is understood will be adopted very soon and carried into effect.

The jetties, themselves, as already stated, are mattresses about 150 feet wide for the first tier, and lesser widths for the succeeding tiers, the final tier near the surface of the water having a superstructure of large capping stones. A portion of the jetty superstructure was built with concrete blocks about 8 feet wide, 12 feet long and 4 feet thick. While there is consid-

erable settlement in the jetties, these concrete caps have gone down uniformly. The total settlement has been about four or five feet since the work has been constructed, and they have since been raised and brought up to above high water, so that all the water now flowing out has a tendency to scour over the bar and not filter its strength over the sides of the jetties.

These inner works that we propose to place are to be constructed of creosoted sheet piles, about 8 inches square, placed close together, with two rows of round piles—all thoroughly braced. As fast as this inner revetment is built, the dredging will be carried on to secure a channel of 35 feet depth and 1000 feet width, and the natural banks formed. The first board thought these banks would build up, but they have not built fast enough to give us the necessary channel.

The work at South Pass was very similar. Mr. Eads began by building the jetties 1000 feet apart and in order to get his 30-foot depth, he had to reduce that to 700 feet, with short spur dikes, which really brought it down to about 600 feet before he attained his width.

In addition to the work at the mouth of Southwest Pass, it is proposed to build at the Head of the Passes short spur dikes of creosoted piles, caps and walings, and brush and rock extending from the banks, so that a channel will be formed not exceeding 5000 feet in width, from a point below Cubit's Gap down to the head of the Passes. Here the river widens too much and a shoal forms, interfering a great deal with the discharge of the Passes, and a uniform depth for navigation.

The foregoing is a brief account of the work and the difficulties to be met. It is a continuous work and will be for some years, until the inner work is started and the extension of the jetties finished. But it is a work of great interest, and one requiring continuous study in contending with Nature in some of her strangest and strongest moods. I thank you very much.

DISCUSSION.

THE PRESIDENT: Gentlemen, I am sure that you have all enjoyed this talk of Colonel Schulz's. I have, very much. I found it very interesting, and, as Colonel Schulz said, there are others here who are more or less familiar with the subject, and still others who may want to ask some questions, and we will be glad to hear from any one now, who has something to say on the subject.

Major Caples is interested in this work. Perhaps he would like to make some remarks on it.

MAJOR CAPLES: I am merely the contractor on the work. The work that we are doing down there is very similar to the work that we do along the banks. We are simply taking the plans furnished us by the New Orleans office, and placing the mats. The mats are of the usual form which we put down. The only difference is that they are much more heavily weighted. Our normal loading of mats is 16 pounds to the square foot. Those mats are loaded with 50 pounds to the square foot. Our normal width of seam is 300 feet wide; down there they run about 120 feet, so we are able to get in two seams a day, as against one seam where we use the 300 feet width.

The problem is one, mainly, of getting material and labor. There is a considerable shortage of material and cars and labor at the present time. We are making the mats for this work in Memphis, and bringing them down the river in large tows to 12-Mile Point, and then running them down to the passes in smaller tows. I think we will possibly get the mats all down, with possibly not the full amount of stone on them, but by the last of this month if we don't get the full amount of stone on them we can get it down later, and get the additional amount of stone on them. We can probably get 25 to 30 pounds per square foot on at this time.

The principal difficulty we find is getting anchorages on our lines. Normally we have a bank that is high enough so that we can dig a trench and fix up a "dead-man" there, but down there we have so little bank above water, in several places, that the working conditions are difficult.

MR. LEWIS: I would like to ask the major a few questions. I notice the major says that they put the sill at the head of Southwest Pass; is that correct?

COLONEL SCHULZ: At the head of South Pass.

MR. LEWIS: I meant South Pass. Now, when Eads dug that pass, the discharge of the Mississippi River through that pass was about 7 1/2 per cent., and he increased it to about 11. Is the discharge through there, the increased cross-section of that pass, in depth as well as in width? Are the banks caving?

COLONEL SCHULZ: The banks are caving, but it is mainly in depth.

MR. LEWIS: And this mattress work, that Major Caples speaks of, is to prevent the caving of the bank?

COLONEL SCHULZ: It is practically to keep it in its present status, not to let it get any bigger. It will not make it any smaller, but will help. That is at the head of South Pass.

MR. LEWIS: Nothing has been done with the Northwest Pass (Pass a L'Outre)?

COLONEL SCHULZ: No, except that we are filling that sill there. There are some deep holes that have recently shown up.

MR. LEWIS: Well, there is another thing that I noticed in your talk, about the head of the passes, you say that the depth there is at times 30 feet, but you get over that difficulty. How do you get over it—by dredging?

COLONEL SCHULZ: We have to dredge. We expect these dykes to relieve the trouble there. I see Mr. Alexander here. He is a contractor and has been on the work. He might want to say something about that. Mr. Dickey, his partner, is also here.

THE PRESIDENT: We would be glad to hear from Mr. Alexander.

MR. ALEXANDER: Mr. President and gentlemen, I don't think I can add much to Colonel Schulz's and Major Caples' talks, but I have been on the work down there since November 1903, seven years under the Engineering Office direction, employed there, and since then as contractor. In the last two or three years I have put 150,000 tons, I guess, of those large capping stones down there; in other words, doing the heavy

work that the major had laid out. It is pretty work, about 90,000 tons of marble,—just about as pretty as you can get for tomb-stones. We get the marble from the Alabama Marble Company, near Birmingham, and it is fairly good marble, at that.

THE PRESIDENT: Mr. Dickey, we would be glad to hear from you, also.

MR. DICKEY: I don't think that I could add anything to the details of the construction work, outside of what has been said on the subject. I had nothing to do with the work, there, except placing it according to contract.

COLONEL SCHULZ: My successor, Major Schley, will have to have the trouble of finishing this. You might ask him about it.

THE PRESIDENT: We would be very glad to hear from Major Schley.

MAJOR SCHLEY: I am sure I cannot give you any information about the passes. I have seen them only once. Colonel Schulz took me down and we visited both South and Southwest Pass. I was particularly interested in the volume of water in South Pass,—threatening to break through the present walls of that pass in several places, and the men on the job down there have to be constantly on the watch, to be sure that a crevasse does not start, because if it starts in the high water, it would be almost impossible to stop it; so the increased volume, and the increased washing resulting from it, is a matter which is making thinner and thinner the walls of South Pass, which are already pretty thin. That impressed me as being something which will indicate the damage which will be done if South Pass is permitted to increase. Of course, the sill now placed at the head of that particular pass, will tend to further limit the increased volume, and therefore the increased scouring, down there. It may be necessary to further limit that, it seems to me, by even raising that sill, possibly, to prevent that volume of water from coming down.

With reference to the work at Southwest Pass, I do not see why what Colonel Schulz has recommended, and which the board has practically adopted, should not bring about the result aimed at. It seems to be only a question as to whether that retaining wall there, which is to be built and the material put behind it,

—whether that will be permanent enough. It is simply helping nature to do what it was thought nature would do, as the Colonel pointed out, by the retaining walls as originally built. And, as you can see from that map, a filling has taken place on the inside of that, and it, eventually, might bring about that result, so that by extending the jetties through the bar at the mouth alone, together with the additional years of deposit which will take place, might bring about the same result. So that I think we look upon that as assisting nature, or shortening the number of years that will be necessary to bring about the proper scour.

MR. LAWS: I want to say that I went down to the jetties in 1876 and remained there for twenty odd years, twenty-three years, altogether,—and that the discharge in South Pass increased from about 7 1/2 per cent, as Mr. Lewis said, to about 14, which I think was the maximum, and then it began to decrease, and up to the time I left there, which was in 1899, it was still on the decrease, so it must be that the closing of the Southwest Pass, putting the jetties there, had the effect of increasing the discharge in South Pass again, because we took the discharge measurements just before I left there, and the discharge had decreased from the 14 per cent to about 11 per cent or 10 per cent.

Another thing, when Mr. Eads was building the jetties, and it was going to be of the greatest benefit to New Orleans, the greatest antagonism came from New Orleans. The people who were going to be benefitted most raised the biggest howl about having the jetties there, and put every obstacle in the way of Mr. Eads' success. Fortunately, he was able to overcome them, and the jetties redounded to the benefit of New Orleans.

As far as converging jetties are concerned, I have always thought that that was a mistake, because the lesson taught by Mr. Eads, in decreasing the width of South Pass jetties, was that it was necessary to have the jetties put the average width of the banks of the channel which we are trying to form, and I think that when the work that Colonel Schulz has recommended is completed, the channel will deepen very rapidly.



Discussion on the Boiler Code of the American Society of Mechanical Engineers.

THE PRESIDENT: Gentlemen, most of you will remember that we passed resolutions endorsing the Boiler Code which was recommended by the American Society of Mechanical Engineers. It would seem that that code did not go through just as it was drawn up. They are still working on it, and it would seem now that they are trying to get a National Code passed by the Federal Government, and we have gentlemen here this evening who are more or less familiar with what is being done. I believe Mr. Lockett has kept up with it, and we would be glad to have some enlightenment, to see how far we have progressed.

Mr. Lockett, can you tell us anything about this?

MR. LOCKETT: Mr. President, Mr. Durban, who is here, has had charge of that work, and I think that he could tell you more about it than I can.

THE PRESIDENT: We would be very glad to have Mr. Durban tell us about it, because we have endorsed this code, and if there is any hitch in it, why, we are naturally interested and want to know about it.

MR. DURBAN: Mr. Chairman and gentlemen, I have been interested in this subject from a manufacturer's viewpoint for a good many years, and, of course, when the American Society got up this code it was necessary, then, for the interested people to take it up and work it out throughout the United States. It is a "safety-first" movement, and of course you all understand just what is back of it. The progress that has been made by the association that took it up has been very great. The publicity has been great, and we have succeeded in getting five States to adopt this code. There has been called, now, by the Industrial Board of the State of Ohio, a meeting at the Willard Hotel at Washington, on the 4th of December, to get all of the States in the Union to send representatives there to discuss this code, and the general betterment of boiler laws.

In this State, it was not possible for us to get the code through; there was a constitutional impediment. We could not get it through, under the present constitution of the State, in

the proper manner, so that we had an enabling act passed here, and now I am appealing to this organization to co-operate with the governor to the end that Louisiana be represented at this meeting at the Willard Hotel in December.

It appears that it will have to be some organization that takes action, from the fact that there are no available state funds to send a representative there. As a matter of fact, there was an act passed by your legislature, recommending that a committee of five be appointed, without compensation, to go over the A. S. M. E. Boiler Code and make recommendations to the legislature as to adopting the code in this State, and there the matter stands.

This meeting at Washington, of course, will be a very important one. There is now a movement before the American Society to get an Advisory Committee on the Boiler Code, and this Advisory Committee to be composed of a representative from each state that adopts the code, and then a clearance house, so that all rulings on the code will be the same, and the work thus will be national in its scope. Whether or not the American Society will adopt that policy, will be determined at their next meeting. We hope at this meeting to have at least one member of the Federal Relations Committee there, to speak on this subject. As a matter of fact, it is a matter for that committee to handle, because now you do not have a free exchange of trade between the states so far as boilers are concerned. One reason why this meeting was called by the Ohio board was a conflict between the Ohio rules and the Pennsylvania rules. The United States Steel Corporation operates plants, a good many of them, down the valley, close to the line, and when a shovel gave out recently in Ohio they telephoned down to Pennsylvania, within ten miles, to send over a shovel, and they could not operate it because the boiler would not pass the code. So that the State itself has now got into the same predicament that the individual boiler-makers were in, and the individual contractors were in, and I hope that something can be done to enable Louisiana to be represented at this meeting.

I think there is no doubt in anybody's mind as to the necessity of boiler legislation and the boiler code. With the safety

movement as it is, it is not debatable; there is no question at all that it is necessary legislation, and it is necessary to have it uniform. I talked to Mr. Lockett, and he thought that something could possibly be done towards getting a representative, and getting the governor to appoint this board, for instance, and let one of those five men, or as many of them as can, go to this meeting.

Mr. Luck had to do with the measure that was passed by the last legislature, and we met with no opposition at all. Everybody wanted a boiler code, but we could not get it because it could not be legislated into law. It must be an enabling act. If the code is written on the statute books of the state, and not administered through a proper committee, then you will get great confusion, because as the art of boiler-making advances, or any slight change is wanted in the code, it can only be done, then, by act of legislature, so it really must be worked out by a governing board, and we have got, as I said, far enough along to have this recommendation made to the governor, and of course, if it stops there, and nobody in the state pushes it, why, the probability is that it will die there.

MR. LOCKETT: Mr. Chairman, I would suggest that you call on Mr. Luck to explain the status of the legislation as it now stands.

THE PRESIDENT: Mr. Luck, will you explain that to us?

MR. LUCK: Professor Creighton was selected by the Boiler Code Committee to take this matter up with the legislature, but he went off on his vacation, and at the request of the chairman of the committee I went to Baton Rouge and conferred with Professor Kerr. We appeared before the Senate committee and we had an act drawn up that we wanted to get through, but in discussing it with Senator Davey, chairman of the committee, and other members of the committee, it was at once pointed out that under the constitution of the State of Louisiana every law passed must have all of the i's dotted and all of the t's crossed, and if any changes should come up, you would have to wait until another session of the legislature. After considering the matter very carefully, with a full committee of the house, the suggestion came—I think pos-

sibly from myself—that they report the act by substitute, that is, a concurrent resolution, and it was passed,—requesting or directing. I forget which, whether it was requesting or directing,—I think directing the governor to appoint a committee of five experts to consider this matter very carefully and report to him, so that he could embody in his next message to the legislature, if he saw fit, the advisability of adopting the uniform boiler code, and the means of doing it. The suggestion came from Senator Davey that possibly it would have to be done in the manner in which the Board of Health of this state is organized—they are given certain powers to adopt regulations, with the power to change those to meet the exigencies as they arise. In that way, you don't have to have the code written into the law, for the American Society might want to change the code as the art progresses.

The governor has not yet appointed that committee, and pardon me if I say this: I think it is up to the Louisiana Engineering Society to take some means to have the governor appoint that committee. I think he is very favorable to it, I know it personally, and I think he is just waiting some suggestion, and I think this is the proper body to do it,—not to suggest the names, possibly, but that he appoint a committee, and take the Engineering Society for the names, if he so desires.

I don't think there was a dissenting voice in the House or Senate, or any person that I have yet met in this state,—and I have given considerable thought to it and discussed it with a great many people. A number of people have written their legislators about this, both in the Senate and the House, and every man Professor Kerr and I met, from the governor down, was thoroughly in favor of doing this, if it was possible to do it under our law, and I think they will do it, and I know the governor is very much interested in this and will do his share, if it is properly presented to him.

MR. GREGORY: Mr. President, I move that the chair be authorized by the Louisiana Engineering Society to write the governor and offer him our services, if they are wished, in this matter.

(This motion was duly seconded.)

MR. LOCKETT: That letter to the Governor, Mr. Chairman and Mr. Gregory, I think ought to explain the necessity for doing this right now; by reason of this meeting at Washington, so that the governor would know it was something to take place soon. When is that meeting to be held, Mr. Durban?

MR. DURBAN: The week of December 4th.

THE PRESIDENT: Gentlemen, you have heard the motion, that the Chair be authorized to write the governor and tender the services and co-operation of this society, if he so desires, in the appointing of this committee. Is there any discussion on that motion—

MR. SHAW: Question.

THE PRESIDENT: If not, we will put it to a vote.

(The motion was declared carried.)

THE PRESIDENT: The chair would be very glad to have the co-operation of some of you gentlemen, who are more familiar with this, to shape up a letter, and get this done right away, so as not to lose any time.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Regular Meeting of the Board of Direction, October 9, 1916.

The meeting was called to order with President Young in the chair and Messrs. Dusenbury, Gregory, Klorer, Manley, Olsen and Hogg present.

Minutes of the previous meeting were read and approved.

Ballots for the election of new members were opened. There were 47 formal and 2 informal ballots. The following were elected:

Non-resident Member—O. F. Reiszner, Leecompte, La.

Resident Junior Member—S. D. Jackson, 533 Baronne Street, New Orleans.

Transfer from Student to Non-resident Junior Member—H. M. White, Stamps, Ark.

Application of Mr. H. D. Shaw of Gulpfport, Miss., for Non-resident Member was approved and ordered held over.

The resignation of Mr. R. R. Porterfield, Student Member, was read and accepted with regret.

To enter our Proceedings under second-class matter, the following resolution was passed:

“RESOLVED, That of the \$3.00, \$5.00, \$6.00, \$10.00, \$12.00 annual membership dues paid in to the Louisiana Engineering Society, \$2.00 shall be for a year's subscription to the 'Proceedings of the Louisiana Engineering Society.' ”

The resolution passed at the meeting September 11, 1916, was ordered rescinded.

A communication from the Committee on Nitrate Plant, Nashville Section, Engineering Association of the South, was read. The Committee asked our Society to endorse the establishment of the nitrate plant, for which Congress has recently appropriated \$20,000,000.00, at Muscle Shoals, in the Tennessee River, near Florence, Ala. The following resolution was passed:

WHEREAS, At Muscle Shoals, in the Tennessee River, near Florence, Ala., are combined in singularly fortunate conjunction, the advantages of strategic position, cheap and concentrated power, abundant associated natural resources, efficient railway and water transportation, temperate climate, immediate availability in times of war, and a never failing market for nitrates in times of peace; and,

WHEREAS, No such combination can be found at any point in the United States, now, therefore,

BE IT RESOLVED, That we endorse the recommendation of the Nashville Section of the Engineering Association of the South, that this site is the logical and proper one at which to establish the nitrate plant for which Congress has recently appropriated \$20,000,000.00; and,

RESOLVED FURTHER, That to divide the plant into sections for the purpose of securing the necessary power, or for furthering local self-interests, is unwarrantable, unwise and contrary to fundamental economic and strategic principles.

A new form of application for membership in the Society, and a blank form to be filled in by endorsers of applicants, were submitted by the Membership Committee. It was moved and carried that the new forms be adopted.

The question of ordering the new membership cards for 1917 was taken up. The Secretary stated that the cost would be around \$16.00. After a discussion, it was moved and carried that the issue of membership cards be temporarily dispensed with.

The matter of submitting a list of names to the Governor, from which to make appointments to fill the five vacancies on the Louisiana State Board of Engineering Examiners, was discussed. It was moved and carried that the following names be submitted:

I. W. Sylvester, Alexander, La.
A. M. Shaw, 1001 Hibernia Bldg., New Orleans, La.
B. W. Pegues, L. S. U., Baton Rouge, La.
Donald Derickson, Tulane University, New Orleans, La.
Frank H. Waddill, Tulane-Newcomb Bldg., New Orleans, La.
W. B. Robert, Opelousas, St. Landry Parish, La.
W. H. P. Creighton, Tulane University, New Orleans, La.
Thos. L. Willis, City Hall, New Orleans, La.
J. M. Rhodes, Napoleonville, La.
J. T. Bullen, Shreveport, Caddo Parish, La.
Duncan Buie, Raceland, La.

The following bills were approved for payment:

Concrete Cement Age Pub. Co., 2 years subscription.....	\$ 2.50
Tulane University Press, printing and postage.....	12.25
Owen Gernon, binding 7 volumes magazines.....	9.00
C. P. Eilerson, papering library.....	25.00
W. T. Hogg, Secretary, salary and incidentals.....	32.50

The financial statements of the General Fund and Cash Account were submitted by the Secretary and accepted. The statements showed a balance in the General Fund for the first nine months of 1916 of \$542.15, and cash on hand, after paying all bills, \$559.71.

There being no further business, the meeting adjourned.

W. T. HOGG,
Secretary.

Regular Meeting of the Society, October 9, 1916.

The meeting was called to order with President Young in the chair and 60 members and guests present.

Minutes of the previous meeting were read and approved.

Mr. Shaw, chairman of the Library Committee, reported that only 12 replies had been received recommending new books for the library. About 27 books had been selected, and the total list price of these books amounted to about \$125.00.

Mr. Williams, chairman of Division B, Publication Committee, reported that the revenue from advertisements had increased every issue since the start.

Mr. Olsen, chairman of Division A, Membership Committee, reported that the committee had a line on 25 or 30 prospective members that needed a little pushing to get them over, and the committee will get after them shortly.

The technical exercises of the evening were then held. Colonel Edward H. Schulz gave a very interesting talk on "Improvements of the Passes of the Mississippi River." This was followed by considerable discussion, after which Colonel Schulz was tendered a rising vote of thanks.

Mr. A. M. Lockett was requested to report on the progress of legislation on the new Boiler Code of the American Society of Mechanical Engineers. Mr. Lockett stated that Mr. Thos. E. Durban, general manager of the Erie City Iron Works, Erie, Pa., was present and could tell us about it. Mr. Durban stated that the Industrial Commission of Ohio intended calling upon the Governors of all the States of the Union to send a representative to Washington on December 4, 1916, to discuss the desirability and advisability of the passage of a national law regulating boiler practice. Mr. Durban asked the Society to coöperate with the Governor in order that a representative from Louisiana will be sent to that meeting.

Mr. Wm. P. Luck, who was active in securing the passage of Act No. 276 at the recent session of the Legislature, was asked to report on recent developments. Mr. Luck stated that the Act No. 276 as finally passed by the Legislature of 1916 at Baton Rouge provides for the appointment by the Governor of a commission of five boiler and machine experts to examine the A. S. M. E. Code, and report to the General Assembly in 1918 whether or not, in their opinion, same should be adopted as a law of this State. Mr. Luck urged the Society to take steps to get the commission appointed, to prepare the report.

Mr. Gregory moved that the Chair be authorized by the Society to write the Governor and tender our services and coöperation in the appointment of the commission. The motion was seconded and carried.

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

W. T. HOGG,

Secretary.

Regular Meeting of the Board of Direction, November 17, 1916.

The meeting was called to order with President Young in the chair and Messrs. Dusenbury, Gregory, Klorer, Manley and Hogg present.

The minutes of the previous meeting were read and approved.

The report of the special committee appointed to coöperate with the committee of the American Society of Civil Engineers on "A National Water Law" was read and accepted.

A report from the Library Committee was read and accepted. The report recommended the installation of a telephone in the Library. It was moved and carried that the President be authorized to negotiate for a telephone to be installed in the Library.

A communication from the Franklin Institute of Philadelphia was read. It inquired if exchange relations with our Proceedings would be agreeable. It was moved and passed that we exchange Proceedings.

A communication from the Committee on Engineering Coöperation was read. It asked for suggestions for the best place to hold the next conference on Engineering Coöperation, and suggestions for topics that might be discussed. It was moved and carried that the Secretary be instructed to reply that we consider ourselves too far removed from the center of activity of this movement to suggest the best place to meet.

A form of application for Student Member was submitted by the Secretary and approved.

The resignation of Mr. J. G. Bennett, Non-Resident Member, was read and accepted with regret.

The resignation of Mr. Leo Steckler, Student Member, was ordered laid over.

The application of Mr. Robert W. Nolte for Resident Member, approved by the Membership Committee, was approved.

The following bills were approved for payment:

M. C. Le Jeune, Stenographer.....	\$ 56.00
Engineering Magazine Co., Eng. Index 1916.....	3.00
Stauffer-Eshleman Co., doorstops in Library.....	1.50
Fabacher's Rathskeller, refreshments, Sept-Oct.....	14.00
Farish Art Store, picture of President frame.....	.50
Tulane University Press, October Proceedings.....	193.45
Tulane University Press, printing and postage.....	23.45
Army Service School, Fort Leavenworth, Kans. (Library).....	18.30
Am. Society Testing Materials Proceedings (Library).....	36.80
W. T. Hogg, Secretary, salary and incidentals.....	37.55

The financial statements of the General Fund, Proceedings Fund, and Cash Account were submitted by the Secretary. The statements showed a balance for 1916 to date in the General Fund, \$604.20; Proceedings Fund, \$448.63, and cash on hand after paying bills, \$627.38.

There being no further business, the meeting adjourned.

W. T. HOGG,
Secretary.

Regular Meeting of the Society, November 13, 1916.

The meeting was called to order with Vice-President Dusenbury in the chair, and 42 members and guests present.

Minutes of the previous meeting were read and approved.

The report of the Special Committee appointed to coöperate with the Committee of the American Society of Civil Engineers on "A National Water Law" was read and approved.

A report from the Library Committee was read and accepted. The report recommended that the individual members should make an effort to secure books by donation, especially books that were out of print, for example, Humphreys and Abbott Report on the Mississippi River. The committee also recommended the installation of telephone service in the Library.

The technical exercises of the evening were then held. A paper by Mr. H. A. Pallfelt, entitled "The Petroleum Industry in Louisiana," was read by Mr. Douglas Anderson, as Mr. Pallfelt had been called out of town. The paper was followed by a discussion on the future of the Petroleum Industry in Louisiana.

Mr. A. M. Shaw suggested that a paper written in popular style, listing commercial oils, stating their particular application, and the best way to use them, would be of great value to the members.

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

W. T. HOGG,
Secretary.