

PROCEEDINGS
OF THE
LOUISIANA
ENGINEERING SOCIETY

VOL. XIII. 1927

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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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Secretary, FRANK A. MUTH, 7705 Willow Street.
Treasurer, WALTER B. MOSES, 425 S. Peters Street.

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Building, Jackson Square.

All business communications should be addressed to F. A. Muth, Secretary,
7705 Willow Street, New Orleans, La.



EDWARD S. LANPHIER

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. XIII.

FEBRUARY 1927

No. 1

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EDITORIAL NOTES AND COMMENT

President Lanphier. At the annual meeting held January 15th, Mr. Edward S. Lanphier was elected President of the Louisiana Engineering Society.

Mr. Lanphier is a native son of Louisiana, born in New Orleans, May 8, 1873, his parents being James Sewall Lanphier and Camille Bright. He received his education in the public schools of New Orleans and in the Tulane High School, then in existence as a preparatory department of Tulane University.

At the age of eighteen Mr. Lanphier entered the Lighthouse Service of the U. S. Government and has been connected with the service continuously since that time, being promoted through the various grades to his present rank of Senior Light-house Engineer, with the duties of Superintendent of Light-houses, in charge of the Eighth District. The wide scope of his work and the responsibilities of his position are indicated by

the fact that the Eighth District extends from St. Marks in Florida to the Rio Grande in Texas, embracing 1000 miles of coast line, with about 360 employees and 1862 aids to navigation. Mr. Lanphier's office is responsible for the construction, maintenance and repair of all structures and floating equipment necessary to the proper functioning of all these aids to navigation.

A member of the Louisiana Engineering Society since 1918, he has served upon its Board of Direction, been a Vice-President, and has contributed to its technical programs. He also takes an active part in the social and civic life of his native city, being a member of the Pickwick Club and the Members Council of the Association of Commerce. He is the retiring President of the Federal Business Association, and was at one time President of the Southern Athletic Club, in its day one of the most famous athletic clubs in the country. Its former clubhouse is now occupied by the Public School System as the Behrman Gymnasium.

Mr. Lanphier is also a member of the American Society of Civil Engineers.

In his brief response to the toast of "Our New President" at the Annual Smoker, Mr. Lanphier congratulated the members upon the strength and vigor of their organization, due to the careful guidance of past administrations, and expressed the hope that it would continue to show progress in all its activities and become one of the factors of greatest influence in the future development and growth of the city and state.

We second most heartily Mr. Lanphier's high hopes for the welfare of the Society, and we believe that his own administration will bear a most important part in the realization of these hopes.

Other Officers. Mr. John L. Porter was elected to the Vice-Presidency to succeed Mr. Lanphier, and Mr. James M. Todd was elected to the Board of Direction for the three-year term. Mr. Frank A. Muth and Mr. Walter Moses were re-elected to their respective offices of Secretary and Treasurer.

Mr. F. P. Hamilton, as retiring President, becomes a member of the Board of Direction, the remaining two members,

whose terms of office have not yet expired, being Mr. W. L. Foye and Professor F. H. Fox.

"Gentlemen Prefer Blondes." Had Miss Anita Loos ever felt any doubts as to the truth of the assertion which forms the title to her amusing little book, these doubts would have been dispelled by a visit to the 1927 Smoker of the Louisiana Engineering Society.

For when the graceful little blonde dancer with her boyish bob and her boyish form tripped gaily up and down the Chess Club Dining Room between the long lines of tables, the audience literally rose to its feet and gave her a rousing ovation.

And in bestowing this special praise upon one of the entertainers of the evening, it is by no means intended to neglect the others, particularly the little brunette who sang and danced most gracefully, as well as the young woman and the young man whose songs contributed greatly to the success of the program.

But when "Blondy," as she was immediately named by popular acclaim, appeared and did a few of those Charleston steps with some other particularly fancy ones thrown in by way of *lagniappe*. Oh well, you know * * * * *

After the above statements it seems superfluous to add that Messrs. Olsen and Moses constituted the Entertainment Committee.

Mr. David Whyte Stewart, of Scotch antecedents, was toastmaster and he proceeded, from the first stroke of the gong through till the final count, to keep the proceedings up to a high pitch of fun and informality.

The spirit of the occasion may be described in the following quotation from a note of thanks received by Mr. Muth from Major W. H. Holcombe, U. S. Corp of Engineers, one of the invited guests at the Smoker:

"I learned a lot from your society as to how a gathering of that kind can be taken out of the domain of formality and stiffness, and can be made an occasion of genuine fun and pleasure. I guess it was a sample of Southern hospitality, which I had heard of but am now beginning to appreciate."

Besides Major Holcombe, the other invited guests were President A. B. Dinwiddie of Tulane University, Major Malcolm Elliott and Colonel W. P. Wooten.

The Engineer as a Field Artilleryman. Under this title Captain Mann contributed a paper to the program of the Society at the December meeting. His principal object was to set forth the engineering aspects of the field artillerymen's duties and to appeal to the patriotism of the young engineer to enlist his services as a reserve officer in this branch of the service. The paper was illustrated with lantern slides, and Captain Mann exhibited a number of technical instruments and apparatus of a scientific and engineering character used in connection with the operations of the artillery.

In the brief discussion following the presentation of the paper, the question was raised as to whether the young man with technical training, and desirous of contributing his quota to the reserve strength of his country's national defense, should enlist in the engineering division or in the artillery division.

This would seem to be largely a matter of preference to be decided principally by the predilections and tastes of the particular individual.

However one may decide this question, it is certainly an outstanding fact that the World War was fought out along scientific and engineering lines, and there was a place for the services of every man with technical training. It is safe to predict, further, that the next great war will be fought on a very much more highly specialized scientific basis than was the last.

Registration of Engineers. The State of Louisiana now has laws for the compulsory registration of Civil Engineers, Architects and Surveyors. Sporadic attempts have been made to have a similar law passed for Mechanical Engineers, and there would appear to be no good reason why compulsory registration should not be applied to all branches of the profession of engineering.

A committee of engineers, appointed from the membership of the Louisiana Engineering Society, in co-operation with a

similar committee of architects, is now engaged upon a careful review of the whole situation with regard to future legislation affecting the registration of architects and engineers.

There is no title more abused in this country than that of "Engineer," unless it be that of "Professor." Physicians and lawyers protect themselves in the practice of their respective professions by examinations to test their fitness and by a system of registration which follows automatically therefrom. The responsibilities which rest upon the engineer in the performance of his duties is fully as great as those in either medicine or law.

The best men in the profession, throughout the whole country, believe that compulsory registration based upon some form of test or examination of fitness will go far toward dignifying the title and protecting the competent and honest practitioner, as well as the general public, against the incompetent and often unscrupulous man whose activities are only limited by the unwillingness of the general public to employ him. And every engineer knows how many projects, both of a public as well as a private nature, are entrusted to so-called engineers.

The difficult part of the problem for the committee will be the decision as to the type of Examining Board which would be necessary to carry out the law if one were passed. Will it be necessary to have a separate board for each of the many highly specialized branches of engineering, or will it suffice to have a single board and to give the applicant an examination in the more general or broader phases of the science of engineering?

It would seem to the writer that the problem will ultimately have to be solved by the establishment of some form of general examining board to cover the requirements of the whole field of engineering. Graduates of approved schools of Civil Engineering are now exempt from examinations by the Louisiana State Board of Engineering Examiners. The ranks of the physicians and lawyers are almost entirely recruited from the graduates of approved schools, who take certain standard examinations immediately upon graduation.

There are almost as many highly developed specialists in the practice of medicine as there are in engineering. Recruits

to the ranks of the engineers will come more and more from the schools. Their induction into the ranks of the engineering profession and their assumption of the title of "Engineer" will follow the general plan referred to above.

Statistics show that of the men now engaged in the practice of engineering, between the ages of twenty-five and thirty years, over sixty-eight per cent. are college trained, and the percentage is increasing rapidly each year.

The statements here made are not to be taken in any sense as arguments against the continuance of the existing boards of examiners for architects and for civil engineers, both of which have done such valient service for the advancement of their respective professions, but rather to point to what seems to be indicated as a logical development in the future.

The Status of the Society. Look over the annual reports published in this issue and you will find some matters of interest concerning the affairs of your Society. There were 441 members on the rolls as of January 1st, 1927.

The cash balance on hand was \$1,619.71.

The cost of getting out the Proceedings for the year was \$1,694.01, receipts being \$2,047.58, leaving a balance of \$353.57.

The funds of the Society which are invested in interest bearing securities amount to \$4,911.37.

And there are other matters of equal interest in the various reports.

PAPERS AND DISCUSSIONS

THE LOUISIANA ENGINEERING SOCIETY AND THE ENGINEERING PROFESSION.

Address of the Retiring President,
F. P. HAMILTON.

During my year as President of the Louisiana Engineering Society, I have given thought to what might be said at this time of general interest to the Society. Two thoughts stand out as being of much interest: One, the advantage of being a member of the Society; and the other, the advancement of the engineering profession.

These will, I feel, make a fitting subject for a brief final address upon retiring from the Presidency.

Public speaking and writing addresses is not a thing which your retiring President would choose as a pleasing pastime, and I fear that engineers in general have much the same feeling; and yet I know of nothing which might be more beneficial to the profession in general than for engineers to advertise themselves more through the medium of public speaking.

The Louisiana Engineering Society affords a splendid opportunity for young engineers, in particular, to take a course in public speaking by joining the Society, attending the meetings, and entering into the discussions.

There is always an interesting paper or address presented at the regular monthly meetings, which treats upon some subject of current interest. These papers are not always technical or confined to strictly engineering subjects. One of the most interesting papers of the past year was on the subject of "Salt Marsh Mosquito Suppression." Even such a paper brings out discussion of interest to the engineer, and especially the Drainage Engineer.

One of the broad and important functions of the Louisiana Engineering Society lies in the co-ordination of members of the various branches of engineering. Our Society accepts members from all branches and has a special provision for student members. Many engineering students of Tulane University avail themselves of this opportunity to associate with the practicing engineers. We also have the grade of Associate Mem-

ber, which permits us to have associated with us contractors and others who may not be engineers, but who are, through the nature of their special pursuit, qualified to co-operate with engineers in the advancement of professional knowledge and practice, and yet are not eligible to membership. They can be transferred to the grade of member when qualified to become such.

In further regard to co-ordination, several of the National Engineering Societies have "Local Sections." Members of these Local Sections are largely members of the Louisiana Engineering Society which brings the various branches of the engineering profession together monthly instead of segregating them in small local sections.

The use of the Louisiana Engineering Society quarters is extended upon request to the various Local Sections and the monthly meetings of the Society are turned over to the officers of the Local Sections—such as those of the American Society of Civil Engineers and American Society of Mechanical Engineers.

During the past year we had one joint meeting with the American Society of Mechanical Engineers, at which there were many engineers of prominence, including four past Presidents of that Society. This meeting had been preceded by an informal banquet given by the Local Sections of the A. S. C. E. and A. S. M. E. Then at the joint meeting in the Louisiana Engineering Society's quarters these Local Sections were joined by many others who were not members of either Local Section, but members of the Louisiana Engineering Society. Other joint meetings have been held with the American Society of Civil Engineers and American Society of Military Engineers.

Through this co-ordination of membership, the Louisiana Engineering Society is enabled to maintain a large, well equipped technical library and reading room, which is kept supplied with current technical magazines and publications of various organizations, such as the American Society of Municipal Improvements, American Wood-Preservers' Association, American Society of Civil Engineers, American Society of Mechanical Engineers, American Society for Testing Materials, and some college technical publications.

Under the law governing the State Board of Engineering Examiners, whenever a vacancy occurs in that Board, the Louisiana Engineering Society is required to submit to the Governor of the State three or more names from which the Governor appoints a new member.

When a new Building Code for the City of New Orleans became necessary, a member of the Louisiana Engineering Society was appointed by the Mayor of the city as chairman of an engineering committee to prepare the new Code. The chairman appointed numerous sub-committees from the membership of the Louisiana Engineering Society to handle the different parts of the Code pertaining to the various branches of the engineering profession. These committees met and conferred with a committee from the American Institute of Architects. The City Commission Council further selected the secretary of the Louisiana Engineering Society to assemble in form for publication the various parts of the Code, and as a result the City of New Orleans is now possessed of one of the best and most up-to-date of all building codes.

The above is intended to show you the important position held in the community by the Louisiana Engineering Society and sets forth reasons why all engineers should be members of the Louisiana Engineering Society if they are eligible, and should attend the meetings whenever possible. The individual will be benefited, and the President and other members will be inspired by a large and interested audience.

"In Union There Is Strength," and engineers should unite more. The Louisiana Engineering Society offers the logical opportunity for union; for closer conduct and for warm friendships.

There are many engineers who no longer practice their profession, but who are engaged in business which brings them into personal contact with the practicing engineer. The Louisiana Engineering Society affords an opportunity for closer friendships in such cases through a short monthly technical meeting, followed by an informal social assembly during which refreshments are served. Looking at it from no other viewpoint than a pecuniary one, it may often be worth your while.

"Comparisons are odious," and yet we engineers find ourselves often comparing our profession with that of doctors, lawyers and others, and to our disadvantage. And why? Because of the lack of strength which comes from union.

Some engineers, and good ones, have attained their high position through the practical school of hard knocks, starting in as rodmen, chainmen, etc., and they are all the more entitled to credit for having worked themselves up to where they hold responsible positions in the engineering profession. But the college trained engineer has to put in as many hours of hard study and experimentation as doctors or lawyers, if not more, and should stand on equally as high a professional plane.

Perhaps engineers are more to blame than any others if they are not so pinnacled. In a talk, recently, to the engineering class at Tulane University, President Dinwiddie told the students that they would find the engineering course difficult but that they would find it worth the effort. Those engineers who have made their mark, or who are well established, should try to help the young engineer to rise and not let him go begging for a "job."

In walking down the street one morning recently I passed a little hole-in-the-wall conducting the business of Labor Agency—no objection, mind you, to the labor agency; it is a good thing in its place. But why should an educated engineer be classed as a day laborer? Here is an exact copy of what I read on a bulletin board in front of this Labor Agency:

WANTED

Waitress.

Draughtsman.

Stenographer—Male, for Central America.

Fender Man—White.

Canvassers—Male and Female.

CIVIL ENGINEER for Central America.

Assistant Bookkeeper—Male.

Man and wife—Colored—for Farm.

Think it over, engineers? White and black, male and female laborers, classed right along with Civil Engineers and Draughtsmen! Is that inspiring to a young man who aspires to be an engineer? It is not. No doctors, no lawyers wanted?

Yes, perhaps so, but they are not located through the bulletin board of a Labor Agency.

Many engineering societies conduct employment bureaus to advantage. Some list only their own members. Others get new members by getting the men jobs first; such as the Philadelphia Engineers' Club and The Affiliated Technical Societies of Boston. The latter report 60% of the engineers listed with their employment bureau as non-members, but their members are directly benefitted by being helped in finding men when wanted. Our own Committee on Employment can help if it is patronized by our own members. As a matter of fact this committee does handle several hundred applications each year and finds jobs for a very large percentage of the applicants.

Get closed together, engineers, and put your profession on the high plane which it merits—at the head of the list of professional men.

Your Society has had another prosperous year. Its meetings have been well attended; the membership has increased; the financial condition is sound. Elsewhere in this volume you will find details which need not be repeated here.

In concluding I want to express my sincere appreciation of the high honor which you have conferred upon me in electing me your President. It will remain with me as something to be cherished. I thank you all for your co-operation and support. I thank the various committees for their work during the year, and then individually I thank your efficient and energetic Secretary for his helpfulness to me and for his conscientious work in taking care of all routine and details in connection with the Society's affairs. And I bespeak your continued co-operation with your new President. Come to the meetings. Inspire him with your presence.

May the Louisiana Engineering Society continue to grow in membership and importance, and may the engineering profession as a whole continue to rise in prominence until it is definitely perched upon that highest pinnacle, where it rightfully belongs, is the sincere wish of your retiring President.

THE ENGINEER AS A FIELD ARTILLERYMAN

BY RALPH H. MANN,

Capt. (141st & 345th F. A.—A. E. F.)

Capt. (167th Separate Bn. F. A. (H) La. N. G.)

“Washington Artillery.”

Read Before the Society December 13, 1926.

The purposes of this paper are to show: 1st, How the Engineer may exert his influence and talents, added to his inherent patriotism, toward the end of rendering to his country that “Bit” of service which he owes her in the furtherance of the already formulated plan of National Defense, The National Defense Act of 1916 and amended 1920-22, and 2nd, How the Engineer is by his training and technical knowledge especially endowed to train, instruct and command units of Field Artillery which, to me at least, is the most interesting branch of the service of our Nation’s land forces.

You may think me professionally unethical or professionally unpatriotic when I try to foist upon you members of the engineering profession an arm of the service other than The Corps of Engineers. I do this advisedly from personal experience. It is my belief that the Field Artillery is as technical, from an engineering standpoint, as the service rendered by the distinguished Corps of Engineers U. S. A., and that it is furthermore the *most technical* (again of course from an engineer’s point of view) of any combatant branch of the Army.

In using the word combatant, please do not imagine for an instant that I wish to belittle the splendid work as exemplified in the heroism, second to none, that our own Engineer troops did as first line combat troops in the history making March, 1918, drive of the Germans on the Western Front. If you will but remember, it was then that the fate of the world swayed in the balance, when the tide of battle almost swept those enemy hosts to victory and bowed the whole civilized world to the will of autocracy and to the galling yoke of militarism. It was then when General Gough’s 5th British Army (which joined the French on their left) met with disaster. It was then again, after those terrible first months of the war and both sides had dug themselves in, that the Germans all but had in their grasp

that goal of high command strategy; namely, the separation of the British from the French—rolling the British back on the Channel and the French around Paris—then to defeat each piecemeal. But though the five kilometer gap had opened and, whether the Germans knew it or not, they stopped. Perhaps they were too far from their bases of supply, perhaps they knew not about the undefended section of the line, but war-time melodrama concerning the High Command's infallibility in seeing all, knowing all, and their equally efficient propaganda concerning their secret service, leads us to doubt this second possibility: perhaps they lacked that initiative in the absence of minutely detailed plans which we, in true American egotism feel is only possessed by Americans;—but at any rate the lull came, the "Putsch" stopped. This lull allowed time for the rushing up of troops of every kind and description who heroically filled the gap and hung on till support came. And among these hastily rushed up troops was a regiment of U. S. Engineers, who did valiant and heroic service until relieved by the "Doughboys."

I do not say that building pontoon bridges across the Marne at Chateau Thierry under a murderous fire, or that those Engineer pioneer platoons who preceded attacks, blowing up barbed wire entanglements, pill boxes, etc., were other than praiseworthy to the nth power.

But where the Engineer was unexcelled in bravery in his service, much of, if not most of, his work was rendered possible by his supporting Artillery with their accurately directed and calculated barrages and concentrations about the points of pontoon bridge construction and on machine gun nests and strong points, as well as upon enemy batteries. And gentlemen, won't you agree with me that the morale, or battle psychology, favors those troops who know that, though they are being made targets of, they are at the same time hitting back, sometimes two or three shells for one, rather than those troops who must work, work, suffer, and die and have no concerted power to retaliate.

We Engineers love to point out that the greatest of American strategists and generals, (and this qualification is made advisedly) Robert E. Lee, was an engineer. He, you know, won his first laurels as a Captain of Engineers on the staff of General Winfield Scott in that successful campaign, resulting

in the capture of Mexico City against enormous odds, the success being generously attributed by General Scott to Captain Lee's strategical efforts.

All artillerymen on the other hand like to point to "The Little Corporal", "The Man of Destiny", Napoleon Bonaparte, who was first and last an artilleryman, and they love to quote that statement of his to the effect that "The Lord is on the side having the most artillery". For the truth of the Napoleonic maxim, may I refer you to but one of the many battles won by artillery preparation during the late war. I refer to the reduction of the St. Mihiel salient, the drive which quickly reduced that great indentation in the French line, and which they had named "The Hernia," was preceded by the heaviest concentration of artillery fire the world had ever seen up to that time. And by the way, that battle, gentlemen, was conducted by the American troops operating "on their own" for their first major engagement of the war. (Chateau Thierry and Belleau Wood were fought in conjunction with the French and, I believe, under their general supervision).

At this point may I presume to present a thought that I feel may tend to reduce in some of us that feeling of false security, that military superiority complex of which all too many good and patriotic Americans are possessed. For it is said, and aptly, that though "America has never lost a war she has never won a peace conference." I feel that it is in the first phase of this quotation that our danger lies. Too many of our loyal citizens (100 per centers all, naturally) feel and express, to non-concurring foreign citizens, (equally 100 per centers from their standpoint) that America and Americans are invincible whether on land, sea, or in the air. It is not difficult to remember a statement made by a patriotic and necessarily idealistic gentleman to the effect that should the clarion call to arms come to our citizenry one fair morning, ere the shades of night had fallen a million of the flower of her young manhood would spring to arms ready to defend her against, and defeat any invader. Will you be kind enough to forgive this admittedly free transcription? Let us admit that there would be one, two, three, even four million men available, and, gentlemen, the admission of those last two figures is indeed

a sweeping admission. But men of what sort? Men of whom a British Colonel, who had been everywhere from India to Singapore, said, that never, in his long military experience, had he seen such fine physical specimens of manhood. But the untrained, ununiformed, and unequipped new arrivals of civilians at the various concentration camps were like a "Howling Mob." And our dawn to dark army without the more or less perfectly organized and functioning administrative organization which our 1917-1918 army had, must be more than a riot. Such men pitted against a trained, equipped and organized force of one-fourth the size would be slaughter comparable to that perpetrated by Von Hindenburg against the Russians in that renowned Masurian Lakes campaign in East Prussia.

Now let us see when that first concentrated and organized American Victory, i. e., the reduction of the St. Mihiel salient, occurred. This battle was fought on September 12 and 13, 1918, seventeen months and six days after the declaration of a state of war had been announced (April 6, 1917). Compare seventeen months and six days to one-half of twenty-four hours. Can you but agree that the comparison is obvious?

Do you think that I am wandering far afield from my chosen subject? If you remember, the first purpose of this paper was to try to show how the Engineer could exert his talent and influence in the essentially important matter of national defense. The above paragraphs try to show why it is necessary that we take an interest in the matter and then we must try to show how the Engineer may best do his individual "Bit."

The National Defense Act of 1916-20-22 divides the land forces of the United States into three groups: I. The Regular Army; II. The National Guard (Federalized); and III. The Organized Reserves.

I. Upon the Regular Army rests the duties of routine administration of Army affairs. This consists of the garrisoning of our own coast defenses and shore lines, interior forts and posts, and the protection of all the outlying possessions and protectorates under the American flag. It has supervision and maintenance of many other activities which, though apparently of non-

military character, have tremendous and direct bearing on National Defense, i. e., The Mississippi River Commission, Inter- and IntraCostal Canal projects, harbor works, public buildings, the Hydrographic Office, the Geodetic and Coast Survey, etc.

The War Department is also responsible for the maintenance of the various schools for officers and enlisted men, the purposes of which are to keep up to date the instruction in combat methods as well as the furtherance of the efficiency of ordnance and equipment used by the combat troops. The officer and enlisted N. C. O. personnel of the Regular Army is used also for the purpose of furnishing instructors for the National Guard, O. R. C. and R. O. T. C. units.

The authorized strength of our Army was 118,750 enlisted men and 12,000 officers of all grades and branches.

The strength of the Army as of June 30, 1926, was 112,856 men and 11,681 officers, excluding the Philippine Scouts.

To quote from Major General Robert C. Davis, Adjutant General of the Army, in his annual report.

"The figures showed that the strength of the army last year was below the authorized average of 118,750 because appropriations for pay of enlisted men 'proved insufficient.' Recruiting was restricted in March this year, and suspended in April. As there was no substantial increase in funds for the current year, further restrictions were imposed after June 30 to hold the enlisted men down to less than 111,000."

It is desired that your attention be brought to the above facts concerning the present strength of our Regular Army. This strength figures approximately 1 soldier to each 1000 of our population.

If you remember the Versailles Treaty, (that direct result of inter-allied "Hymns of Hate" long pent up) allowed defeated Germany an army of some 100,000 armed soldiers for internal police duty, all the outlying possessions having been taken away. To me the comparison is obvious.

II. The National Guard is laid down by the "Modified Man Power Program" of Congress dated January 21, 1923, consists of 250,000 officers and enlisted men.

To transcribe from Major General C. C. Hammond's report, as Chief of the Militia Bureau, dated October 26, 1926.

The Summer Camp of 1925 as consolidated for all the National Guard of the U. S. contained 11,023 or 94% of the officers and 141,947 or 83% of the then Federalized National Guard. The total number as authorized by Congress as of January 6, 1926, amounted to 185,730 enlisted men and 13,630 officers and warrant officers, totaling 172,100 troops of a 250,000 maximum.

All federally recognized units of the National Guard are divided into definite regiments, brigades, divisions and corps, and in the event of a national emergency, are subject to the call of the President for immediate mobilization, plans of which are on file in the headquarters of each individual company, battery or troop, as well as in each higher group of units as tabulated in the various approved Tables of Organization.

The National Guard then joins with the Regular Army and becomes the first real line of defense in the United States of any appreciable available size. This is our citizen standing army.

III. The Organized Reserves denotes the skeletonized civilian U. S. Army which in a few months can be officered and manned to a strength comparable to our Army of 1917-18., or to suit the requirements of the emergency.

The individual units of the Organized Reserves are also organized in plan up to and including the division, corp and army. I am unable to give definite data upon the extent to which the Reserves are officered and manned. The enlisted personnel of the Reserve Corps is however so small as to be almost negligible with perhaps the exception of the high grades of N. C. O.

However, the United States now has a sizable and readily expandible military organization as directed under the provisions of the National Defense Act, and it is the first time that this nation has, since its inception, made a pretense of having any workable plan and structure for the organization of an emergency group of land forces. The one and only thing now lacking to place our National Defense on a going basis is contemplated by the designers of the National Defense Act, is the lack of congressional appropriation necessary for this training.

It is my belief that it is by allying himself with the National Guard or the Organized Reserves that the opportunity and, I feel, the duty of the Engineer lies. The word duty is used advisedly, since we feel that the Engineer is an inherently public spirited and patriotic citizen.

May I presume to make this statement which I always make to new or prospective recruits in my National Guard Battery? It is to the effect that it is my belief that the man who, in time of peace, takes such a personal interest in the question of National Defense that he allies himself with either the National Guard or the Organized Reserves, in order that he may make himself, by such service, more ready to effectively and efficiently "carry on" in case of any unlooked for emergency, is a more patriotic citizen than he who, in time of war, rushes into the service under the influence of what we may call the mob psychology of war time.

[Editor's Note:—The continuation of Captain Mann's paper was a running commentary on the stereopticon slides and a description of some of the apparatus and instruments used in the Field Artillery service. In support of the statement that the Field Artillery offers scope for the technical abilities of all branches of engineering, he submits the following list:

- 1st. The Civil Engineer, Instruments, maps and topographic operations.
- 2nd. The Mechanical Engineer, Ordnance, ammunition materiel.
- 3rd. The Electrical Engineer, Signal, and communications, camp illumination.
- 4th. The Chemical Engineer, Gas, water treatment.
- 5th. The Sanitary Engineer, Camp and field sanitation.
- 6th. The Construction Engineer, i. e., the contractor, gun emplacements, bomb proofs, bivouacs, roads and bridges.
- 7th. The Scientific Engineer, Pure science engineer, as exemplified in that part of the Artillery Information Service work as applied to sound and flash ranging and ballistics.
- 8th. Camouflage, The Field Architect, shadows and coloring.

The attributes of a good engineer may be classified as:

Common sense and initiative in unexpected situations.

Ability to make quick decisions.

Executive ability to carry such decisions to a conclusion.

Ability to handle men and inspire morale.

These same attributes would seem to be a necessary part of the equipment of a good field artilleryman.

In conclusion, Captain Mann compares the somewhat cynical song of the engineer with the inspiring song of the field artillery:

The Engineer:—

“The Sergeant says my rifle’s rusty,
No doubt the Sergeant’s word is right!
But I know that these, my pick and shovel,
Are always polished—shiny bright.”

The Artilleryman:—

Over hill, over dale,
As we hit the dusty trail,
And those caissons go rolling along.
In and out; right about;
Hear those wagon soldiers shout
As those caissons go rolling along.
Then its hi hi hee
For the Field Artilleree.
Shout out your numbers loud and strong
One! Two!
For where e’re you go,
You will always know,
That those caissons go rolling along.
Keep them rolling
That the caissons go rolling along.

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- E. H. COLEMAN, (1922), J. F. Coleman Engineering Co., 220 Hibernia Bldg., New Orleans.
- J. F. COLEMAN, (C. M.), of J. F. Coleman Engineering Co., 220 Hibernia Bldg., New Orleans.
- JOSEPH B. CONVERSE, (1921), Consulting Engineer, 7324 Maple St., New Orleans.
- HENRY BELL COOLEY, (1924), Assistant Engineer, City Hall, 1516 Amelia St., New Orleans.
- J. M. CRACROFT, (1927), Assistant Engineer, Bridge Department, City of New Orleans, 1473 Henry Clay Ave., New Orleans.
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- DAVID L. CULLOM, (1916), Assistant Engineer, Board of Commissioners of the Port of New Orleans, 3620 Baronne St., New Orleans.
- ARTHUR B. DAVIS, (1923), with Virginia Bridge & Iron Co., Box 1048, Memphis, Tenn.
- CHARLES DAVIS, (1925), Engineering Department, Board of Port Commissioner, 5407 Prytania St., New Orleans.
- B. N. DAVIS, (1913), Engineer and Contractor, 1006 Tchoupitoulas St., New Orleans.
- EUGENE F. DELERY, (1915), Design Engineer, Sewerage & Water Board, 3945 Camp St., New Orleans.
- DONALD DERICKSON, (1912), Professor of Civil Engineering, Tulane University, New Orleans.
- JACQUES de TARNOWSKY, (1915), Structural Engineer, Room 25, City Hall, New Orleans.
- J. L. DICKEY, (1915), Civil Engineer and Contractor, 1427 Carrollton Ave., New Orleans.
- M. P. DOULLUT, (1911), Capitalist, 400 Eganla St., New Orleans.
- P. C. DOWELL, (1922), Manufacturers' Agent and Structural Engineer, 4920 S. Robertson St., New Orleans.
- WALLACE CAMPBELL DRENNAN, (1927), Field Engineer in Roadway Dept. of New Orleans Public Service Inc., 819 Lowerline St., New Orleans.
- PETER J. DROMGOOL, (1923), Superintendent Engineer, Southern and Gulf Districts, Mexican Petroleum Corp., 944 St. Charles Ave., New Orleans.
- GUSTAVE ROBERT DUBUS, (1927), President and Manager, Dubus Co., Inc., 3720 Banks St., New Orleans.
- JULES FREDERICK DUBUS, (1927), Construction Engineer of the St. Rose Export Station under C. E. Smith, Box 31, Abbeville, La.

- PETER ARMAND DUBUS, (1927), President and Owner, P. A. Dubus & Son, Inc., 634 Louisa St., New Orleans.
- ARCHIBALD LEE DUNLAP, (1925), Assistant Professor of Mechanical Engineering, Tulane University, 5829 Clara St., New Orleans.
- ALLAN T. DUSENBURY, (1909), Drainage and Reclamation Engineer, 508 Marine Bank Bldg., New Orleans.
- ANDRE C. DUVAL, (1926), with State Board of Engineers, 2237 Milan St., New Orleans.
- GEORGE E. EARL, (1900), General Superintendent, Sewerage and Water Board of New Orleans, Room 402, Sewerage and Water Board Bldg., New Orleans.
- RALPH EARL, (1913), Assistant Director of Water Purification Department, 2142 Eagle St., New Orleans.
- JOHN T. EASTWOOD, (1901), Principal Assistant Engineer, Sewerage and Water Board, Sewerage and Water Board Bldg., New Orleans.
- FRED ECKSTEIN, (1924), Engineer, Plant Department, New Orleans Public Service Inc., 5817 S. Robertson St., New Orleans.
- FRANK P. ELIZARDI, (1924), Sales Engineer, A. M. Lockett & Co., 505 Q. & C. Bldg., New Orleans.
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- WILLIAM L. FEY, (1922), Assistant Engineer, Board of Commissioners, Port of New Orleans, 7819 Willow St., New Orleans.
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- FREDERICK H. FOX, (1922), Associate Professor, Civil Engineering, Tulane University, New Orleans.
- ROLAND WOODWARD FRENCH, (1924), with N. O. Public Service Inc., 3225 Ursuline Ave., New Orleans.
- A. M. FROMHERZ, (1915), President, Jos. Fromherz, Inc., 507 Title Guarantee Bldg., New Orleans.
- FRANK G. FROST, (1919), General Superintendent, Electrical Dept., New Orleans Public Service Inc., New Orleans.
- LLOYD GARNER FROST, (1926), Member of Firm, Hedrick & Frost, Consulting Engineers, 327 Ardis Bldg., Shreveport, La.
- HERBERT M. GALLAGHER, (1921), Consulting Engineer, J. F. Coleman Engineering Co., 228 Hibernia Bldg., New Orleans.
- MARCEL GARSAUD, (1905), General Manager, Board of Port Commissioners, 200 New Orleans Court Bldg., New Orleans.
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- FRANCIS WILLIS GAVIN, (1925), District Manager, Truscon Steel Co., 605 Carondelet Bldg., New Orleans.
- WILL J. GIBBENS, SR., (1900), President, Gibbens & Gordon, Inc., 532-534 Canal St., New Orleans.
- WILL J. GIBBENS, JR., (1924), Secretary, Gibbens & Gordon, Inc., 532-534 Canal St., 1404 Octavia St., New Orleans.
- DAVID W. GODAT, (1924), Assistant Engineer in Charge of Bridges, City Engineer's Office, 7826 Zimple St., New Orleans.
- MAYER GODCHAUX, (1920), 4129 Carondelet St., Apt. B., New Orleans.
- JOSEPH McCORMICK GONDRAN, (1924), Structural Engineer with Lukens Steel Co., Box 320, New Orleans.
- ARTHUR A. GRANT, (1923), Marine Surveyor, Louisiana Bldg., New Orleans.
- WALTER K. GRANT, (1922), 1527 Audubon St., New Orleans.

- EUGENE C. GRAVELY, (1918), Civil Engineer in Private Practice, 705 United Fruit Bldg., New Orleans.
- W. B. GREGORY, (1907), Professor of Experimental Engineering, Tulane University, and Irrigation Engineer, U. S. Department of Agriculture, Tulane University.
- B. H. GREHAN, (1914), 1736 Second St., New Orleans.
- LAFAYETTE F. GRIFFITH, (1925), Assistant Superintendent of Distribution, New Orleans Public Service Inc., 139 S. Rampart St., New Orleans.
- A. H. GUILLOT, (1917), Assistant Engineer, New Orleans Public Service Inc., 201 Baronne St., New Orleans.
- ALLEN S. HACKETT, (1921), Consulting Engineer, 515 Whitney Bldg., New Orleans.
- DAN HALLORAN, JR., (1924), Assistant Engineer, Distribution Department, New Orleans Public Service Inc., 1111 Elysian Fields Ave., New Orleans.
- FARRAR PETRIE HAMILTON, (1915), President, Creosoted Materials Co., 1425 Hibernia Bldg., New Orleans.
- GEORGE R. HAMMETT, (1920), Sales Engineer, A. M. Lockett & Co., 2016 Calhoun St., New Orleans.
- ALLAN J. HARRIS, (1924), President, Walter Castenado, Inc., 1105 Canal-Commercial Bank Bldg., New Orleans.
- CHARLES J. HARDY, (1909), Civil Engineer, 2128 Gayoso St., New Orleans.
- M. V. HAULARD, (1906), Superintendent, Municipal Repair Plant, 4154 Iberville St., New Orleans.
- W. S. HENNING, (1919), Assistant with Board of State Engineers, 213 New Orleans Court Bldg., New Orleans.
- RUDOLPH HERPICH, (1925), Supervising Engineer, Standard Fruit & S. S. Co., 3904 Delgado Ave., New Orleans.
- WALTER H. HOFFMAN, (C. M.), Civil Engineer, Secretary, Board of State Engineers, 213 New Orleans Court Bldg., New Orleans.
- W. T. HOGG, (1913), Assistant Engineer, Board of Commissioners, Port of New Orleans, 7930 Belfast St., New Orleans.
- FRANK L. HOLT, (1915), Electrical Designer, Engineering Department, Board of Commissioners, Port of New Orleans.
- PAUL FROST HOOTS, (1927), Assistant Chief Engineer, New Orleans Public Service Inc., 6319 Story St., New Orleans.
- EDWARD C. HYATT, (1925), Office Engineer, City Engineer's Office, 3802 Prytanla St., New Orleans.
- FRANCIS MARION IVICHIEVICH, (1927), Assistant Superintendent, Crescent Bed Co., 2601 Octavia St., New Orleans.
- LEWIS R. JACKSON, (1922), Sales and Engineering, Walsh & Weldner Boiler Co., Chattanooga, Tenn., 1105 Canal Bank Bldg., New Orleans.
- ALFRED F. JACOBI, (1922), Designer, Dock Board, 5830 Clara St., New Orleans.
- HARRY JACOBS, (1919), Civil Engineer, 264 Audubon Blvd., New Orleans.
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- PAUL F. JAHNCKE, (1908), Vice-President, Jahncke Service, Incorporated; Vice-President, Brookhaven Gravel Co., 814 Howard Ave., New Orleans.
- JOHN M. JENKS, (1920), with Dock Board, 500 Camp St., New Orleans.
- CHARLES JOHNSON, (1925), Assistant Engineer, Sewerage and Water Board, 521 Lowerline St., New Orleans.
- WARREN JOHNSON, (1903), President and General Manager, Johnson Iron Works, Dry Dock and Shipbuilding Company, Inc., P. O. Box 840, New Orleans.
- C. LEONARD JONES, (1923), Designer, with Dock Board, 2427 Camp St., New Orleans.
- ERROL E. KELY, (1920), 602 Queen and Crescent Bldg., New Orleans.
- JAMES P. KEMPER, (1909), Civil Engineer in Private Practice, 901 Cherokee St., New Orleans.
- CHARLES MACDONALD KERR, (1914), Field Engineer, American Wood Preservers' Association, 5831 S. Robertson St., New Orleans.
- JOHN KLORER, (1898), Commissioner of Public Property, City Hall, New Orleans.

- R. B. KOHNKE, (1911), Acting Chief Engineer, Orleans Levee Board, 934 Picheloup Place, New Orleans.
- JOSEPH J. KREBS, (1926), Assistant Engineer in Charge of Street Planning, City Engineer's Office, 4519 Baronne St., New Orleans.
- ALFRED A. LANAUX, (1921), Gulf Pipe Line Co., 513 Gulf Bldg., Houston, Tex.
- HERRICK J. LANE, (1922), Auditor, W. Horace Williams Co., Inc., 1465 State St., New Orleans.
- EDWARD S. LANPHER, (1918), Senior Lighthouse Engineer (Superintendent of Lighthouses), Room 224 Custom House Bldg., New Orleans.
- FERD L. LARUE, (1919), 825 Esplanade Ave., New Orleans.
- LEON LASSEN, (1926), Assistant Engineer, Water Purification Plant, 2708 Cambonne St., New Orleans.
- G. W. LAWES, (1898), Civil Engineer, 918 Broadway, New Orleans.
- RANDALL FRANK LEGEAI, (1923), Home Designer and Builder, 5800 Fontainebleau Drive, New Orleans.
- ALBERT J. LEGETT, JR., (1919), Assistant Superintendent, Johnson Iron Works, Dry Dock and Shipbuilding Co., 5859 Catina St., New Orleans.
- J. H. LEWIS, (1908), 613 Royal St., New Orleans.
- ROWLAND LINFIELD, (1923), Marine Surveyor, 2404 Joseph St., New Orleans.
- A. M. LOCKETT, (1900), President, A. M. Lockett & Co., 501 Q. & C. Bldg., New Orleans.
- GERVAIS LOMBARD, (C. M.), Assistant State Engineer, Board of State Engineers, New Orleans.
- GEORGE LEWIS LORD, (1924), Engineer, 1717 Seventh St., New Orleans.
- THOMAS MICHAEL MCCARROLL, (1926), State Board of Engineers, 1827 S. Dupre St., New Orleans.
- CHARLES S. McFARLAND, (1903), 302 Citizens Bank Bldg., New Orleans.
- J. A. McNIVEN, (1922), Assistant Engineer, Dock Board, 6034 Hurst St., New Orleans.
- ROGER BARTON MEWHORTER, (1927), Special Engineer, Orleans Levee District on Spillways, 201 N. O. Court Bldg., New Orleans.
- JOSEPH P. MAGUIRE, (1923), Refrigeration Engineer, N. O. Public Service Inc., 2805 St. Bernard Ave., New Orleans.
- IVOR ORIN MALL, (1922), with New Orleans Public Service Inc., 201 Baronne St., New Orleans.
- HENRY J. MALOCHEE, (1898), Vice-President and Engineer, Buckmaster-Luck-Malochée, Inc., 201-2 Industrial Homestead Bldg., 617 Common St., New Orleans.
- RALPH G. MALONE, (1924), Chief Engineer, Louisiana Fire Prevention Bureau, 2831 Calhoun St., New Orleans.
- WALTER J. MANION, (1926), Architectural Draftsman with E. M. Reynes, Architect, 822 Perdido St., 1217 Peters Ave., New Orleans.
- RALPH H. MANN, (1921), Assistant Engineer, J. F. Coleman Engineering Co., 228 Hibernia Bldg., 1419 Nashville Ave., New Orleans.
- E. S. MERRILL, (1925), Consulting Engineer, 7509 Jeannette St., New Orleans.
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- JOHN HENRY MURPHY, (1914), 1322 Felicity St., New Orleans.

- FRANK A. MUTH, (1915), Lighthouse Engineer, (Assistant Superintendent) Lighthouse Service, 7705 Willow St., New Orleans .
- ALLEN J. NEGROTTO, (1920) Engineer, with J. W. Billingsley, 4914 S. Claiborne Ave., New Orleans.
- BERNARD STANLEY NELSON, (1911), Chief Engineer, A. M. Lockett & Co., Ltd., 501 Q. & C. Bldg., New Orleans.
- LEROY J. NEWMAN, (1923), with New Orleans Public Service Inc., 201 Baronne St., New Orleans.
- WILLIAM T. NEWTON, (1915), Master Mechanic, U. S. Engineers, 5201 Pitt St., New Orleans.
- WILLIAM F. OAKES, (1918), 344 Camp St., New Orleans .
- THOMAS D. OAKLEY, (1924), Bragman-Bluff Lumber Co., Puerto Cabezo, Nicaragua, C. A.
- JOHN A. O'BRIEN, (1920), Engineer and Contractor, 313 Louisiana Bldg., New Orleans.
- ROBERT M. O'BRIEN, (1916), Superintendent, Rolling Stock and Shops, New Orleans Public Service Inc., 5315 Camp St., New Orleans.
- BENJAMIN J. OLIVEIRA, (1926), Assistant Engineer, Office of City Engineer, 2300 Joseph St., New Orleans.
- OLE K. OLSEN, (1905), Contracting Engineer, 822 Perdido St., New Orleans.
- JOHN H. O'NEILL, (1916), Sanitary Engineer, Louisiana State Board of Health, 637 Lowerline St., New Orleans.
- J. DEVEREUX O'REILLY, (1912), Engineer, 1828 Palmer Ave., New Orleans.
- ADLOE ORR, (1926), Civil Engineer and Surveyor, 6357 West End Bldg., New Orleans.
- ALBERT B. PATTERSON, (1923), Vice-President, New Orleans Public Service Inc., 2021 Peters Ave., New Orleans.
- FRANK T. PAYNE, (1924), Engineer, Conservation Commission, 128 New Orleans Court Bldg., New Orleans.
- JOHN L. PORTER, (1924), Director, Water Purification Station, Sewerage and Water Board, 8407 Panola St., New Orleans.
- PATRICK HENRY QUINLAN, (1926), Assistant Engineer, Office of City Engineer, 1141 Philip St., New Orleans.
- HYMAN RABINOVITZ, (1911), General Contractor, 740 Poydras St., New Orleans.
- GROVER CLEVELAND RACKERBY, (1926), Field Engineer, Board of Commissioners, 4125 St. Charles Ave., New Orleans.
- CHARLESS FREDERICK RANTZ, (1924), Rantz Engineering and Machine Works, 2826 Esplanade Ave., New Orleans.
- LESTER H. RAYNER, (1920), with John H. Murphy Iron Works, 7023 West End Blvd., New Orleans.
- LYMAN C. REED, (1907), Electrical Equipment, 628 Hibernia Bldg., New Orleans.
- HAMPTON REYNOLDS, (1910), General Contractor, 831 Malson Blanche Bldg., New Orleans.
- JOHN RIESS, (1906), Civil Engineer and Contractor, 807 New Orleans Bank Bldg., New Orleans.
- OSCAR RIESS, (1916), Engineer, with John Riess, Civil Engineer and Contractor, 1423 Milan St., New Orleans.
- GEORGE P. RICE, (1924), with Lukens Steel Co., Box 320, New Orleans.
- JAMES M. ROBERT, (1908), Professor of Machine Design, Tulane University, Director Night Classes in Engineering, Tulane University, New Orleans.
- THOMAS H. ROBERTS, (1923), Mechanical Engineer, 1530 N. Broad St., New Orleans.
- EDWIN J. H. RODRIGUEZ, (1918), Zymothecnical Chemist, 143 Park Row, New Orleans.
- EVERETT G. ROESSLE, (1926), Assistant Engineer, with S. A. Colongne Sons, New Orleans.
- RAGUWALD P. RORDAM, (1920), Civil Engineer, 6322 S. Liberty St., New Orleans.
- BLAIR A. ROSS, (1925), Assistant Engineer, Fourth Mississippi River Commission District, 1716 Milan St., New Orleans.
- ELBERT GILBERT SANDOZ, (1927), Private Practice. Surveying Suburban Development and Heavy Building Construction, 4218 S. Liberty St., New Orleans.

- CARL SCHNEIDER, (1926), Aide to the Commissioner of Public Property, 7711 Plum St., New Orleans.
- GEORGE C. SCHOENBERGER, (1919), Chief State Engineer, 213 New Orleans Court Bldg., New Orleans.
- ARTHUR M. SCOTT, (1915), Engineer, with Ole K. Olsen. Concrete Engineer, 822 Perdido St., New Orleans.
- HARRY D. SCOTT, (1920), Assistant General Manager, Standard Fruit and S. S. Co., Union Indemnity Bldg., New Orleans.
- GEORGE ARTHUR SEAVER, (1920), Chief Engineer, George J. Glover Co., Inc., 1219 Eleonore St., New Orleans.
- SOLIS SEIFERTH, (1927), Architectural Engineer, Secretary-Treasurer, Weiss and Dreyfous, Inc., Malson Blanche Bldg., 5339 St. Charles Ave., New Orleans.
- ARTHUR M. SHAW, (1910), Consulting Engineer, 1403 Pere Marquette Bldg., New Orleans.
- LESTER C. SMITH, (1920), Secretary-Treasurer, Doullut & Ewin, Inc., 419 Meaher Bldg., Mobile, Ala.
- THOMAS SMITH, JR., (1925), Engineering Department, New Orleans Public Service Inc., 2406 Jena St., New Orleans.
- CHARLES E. SNYPP, (1922), Engineer, with Southern Cotton Oil Co., Gretna, La.
- EDWIN GUY STARBUCK, (1927), Contracting Engineer, Virginia Bridge & Iron Co., P. O. Box 785, New Orleans.
- REINHARD A. STEINMAYER, (1925), Assistant Professor of Geology, Tulane University, 1217 Calhoun St., New Orleans.
- DAVID WHYTE STEWART, (1920), Chief Engineer, N. O. Public Service Inc., 2329 General Pershing St., New Orleans.
- WAYNE DUDLEY STEWARD, (1925), Field and District Engineer, Portland Cement Association, 1227 Henry Clay Ave., New Orleans.
- JOSEPH L. SWANSON, (1922), President, Swanson-McGraw Co., Consulting Engineers, 425 Baltar Bldg., New Orleans.
- ALFRED F. THEARD, (C. M.), Drainage Engineer, Sewerage and Water Board Bldg., New Orleans.
- JAMES M. TODD, (1923), Engineer, with A. M. Lockett & Co., Ltd., 2433 Pine St., New Orleans.
- FREDERICK G. TUPPER, (1922), 1201 New Orleans Bank Bldg., New Orleans.
- EUGENE UNSWORTH, (1919), Assistant Chief Inspector, New Orleans Department Hartford Steam Boiler Inspection and Insurance Co., 1128 Hibernia Bank Bldg., New Orleans.
- BRYSON VALLAS, (1925), City Engineer, Room 25, City Hall, 4239 Iberville St., New Orleans.
- GEORGE E. VINNEDGE, (1927), Superintendent of Construction, City Park, 3439 Prytanla St., New Orleans.
- GILBERT D. VON PHUL, (1916), Engineer, Contractor, Manufacturer; Office and Works, St. Patrick and St. Louis Sts., New Orleans.
- FRANK H. WADDILL, (1898), Consulting Civil Engineer, 407 Tulane-Newcomb Bldg., New Orleans.
- GEORGE D. WADDILL, (1911), Assistant Engineer, U. S. Engineering Office, 5219 Camp St., New Orleans.
- J. D. WALKER, (1908), Engineer for Craven & Lang, Carondelet Bldg., New Orleans.
- ALLEN E. WASHBURN, (1908), Civil Engineer, U. S. Engineer Office, Dauphine and Poland Sts., New Orleans.
- ALFRED L. WEBRE, (1913), Specialist on Heating and Evaporation of Solutions, St. Davids, Penn.
- LEO S. WEIL, (1918), Mechanical and Electrical Engineer; President, Engineering Sales Co., Inc., 425 St. Peters St., New Orleans.
- LEON C. WEISS, (1918), 600 Malson Blanche Bldg., New Orleans.
- BEN WILLARD, (1900), Local Manager, General Electric Co., 1004 Union Indemnity Bldg., 7111 Freret St., New Orleans.
- ELMER WILLIAMS, (1927), Contractor, 5520 S. Franklin St., New Orleans.

- W. HORACE WILLIAMS, (1908), President and General Manager, W. Horace Williams Co., Inc., Engineers and General Contractors, Southern Bldg., 833 Howard Ave., New Orleans.
- C. S. WILLIAMSON, JR., (1916), Head of School of Chemical Engineering, Tulane University, New Orleans.
- ARMAND L. WILLOZ, (1922), Engineer, Orleans Levee Board, 4439 S. Miro St., New Orleans.
- VICTOR L. WILLOZ, (1900), Distribution Engineer, New Orleans Public Service Inc., 911 Common St., New Orleans.
- RUSS FAULKNER WILLS, (1926), Assistant Engineer and Terminal Engineer, Southern Pacific R. R., 2633 Napoleon Ave., New Orleans.
- J. NORMAN WILSON, (1911), Assistant Engineer, Mechanical Engineering Department, Sewerage and Water Board, 2425 Audubon St., New Orleans.
- WALTER E. WINSHIP, (1921), Marketing and Distributing Petroleum Products, 1404 Whitney Bldg., New Orleans.
- A. R. WINGATE, JR., (1924), Engineering Department, Lukens Steel Co., 1731 Robert St., New Orleans.
- ALBERT G. WYLER, (1927), Assistant Engineer in Charge of Field Construction of Bridges, 530 Jackson Ave., New Orleans.
- CHARLES J. WYLER, (1919), Principal Assistant Engineer, A. M. Lockett & Co., Ltd., 530 Jackson Ave., New Orleans.
- LOUIS J. WYLER, (1922), Superintendent, Lukens Steel Co., Box 320, New Orleans.
- SAMUEL YOUNG, (1911), Chief Engineer, Port Commission, 500 Camp St., New Orleans.
- HENRY L. ZANDER, (1898), Civil Engineer, 821 N. Rampart St., New Orleans.
- ANTHONY M. ZIBILICH, (1922), Associate Lighthouse Engineer, U. S. Lighthouse Service, 3228 Florida St., New Orleans.

NON-RESIDENT MEMBERS.

- JAMES R. ADAMS, (1911), Lake Providence, La.
- ORLANDO P. ADAMS, (1920), Division Plant Superintendent, Florida Power and Light Co., Miami, Fla.
- FELIX L. ALCUS, (1922), Vice-President, Carbine-Harang Machinery & Supply Co., 1001 Annunciation St., New Orleans.
- LEWIS SCHERCK ALCUS, (1922), 7445 Maple St., New Orleans.
- WINSTON ATTEBERRY, (1926), with Louisiana Highway Commission, Baton Rouge, La.
- J. NELSON BALL, JR., (1926), Resident Engineer, Louisiana Highway Commission, Baton Rouge, La.
- JAMES ALLEN BARKSDALE, (1926), Assistant City Engineer, Box 691, Gulfport, Miss.
- JOHN H. BATEMAN, (1925), Louisiana State University, Baton Rouge, La.
- JOSEPH P. BERANGER, (1915), Chief Engineer, Cuban Dominican Sugar Corp., 129 Front St., New York City.
- M. A. BERANGER, (1918), General Manager, Bernard Lodge Central, Orange Lane, Jamaica, B. W. I.
- MERRILL BERNARD, (1917), Consulting Engineer, Crowley, La.
- JOS. M. BING, (1917), Consulting Engineer, 152 West 42nd St., New York City.
- ELDRED GRIFFIN BLAKEWOOD, JR., (1926), Resident Engineer, Bridge Construction (Steel, Conc. & Timber), Location Surveys for Bridges and Roads, Baton Rouge, La.
- PAUL BONHAM, (1926), with Geo. G. Ehrenborg, C. E., Gulfport, Miss.
- R. W. BRINGHURST, JR., (1912), Commissioner Parks and Streets, P. O. Box 706, Alexandria, La.
- FOREST LEROY BUCKLEY, (1923), Resident Engineer with J. W. Billingsley, Harrisonburg, La.
- JACOB THOMPSON BULLEN, (1925), Caddo Parish Engineer, Box 772, Shreveport, La.
- JOHN CALLAN, (1918), 1533 Felicite St., New Orleans.
- H. F. CAMERON, (1914), Public Service Company of Oklahoma, Tulsa, Okla.

- THEO. F. CHENET, (1922), Resident Engineer, New Smyrna, Fla.
- L. C. DATZ, (1906), Newman, Saunders & Co., Inc., 506 Olive St., St. Louis, Mo.
- JOHN J. DAVIDSON, (1918), care Avoca P. O., Morgan City, La.
- GEORGE H. DAVIS, (1909), Member Ford, Bacon & Davis, Inc., 115 Broadway, New York City.
- WILLIAM F. EBLEN, (1916), Secretary-Treasurer Engineering Service Corp., 1806 Post Dispatch Bldg., Houston, Texas.
- L. P. ELBERSON, (1911), Superintendent, Louisiana Irrigation & Mill Co., Crowley, La.
- S. WALLACE ELBERSON, (1911), Engineer with A. M. Lockett & Co., Crowley, La.
- CHARLES H. FENSTERMAKER, (1914), Chief Engineer, Industrial Lumber Co., Engineer, Road District No. 5, Allen Parish, Elizabeth, La.
- FRANCIS T. FOOTE, (1909), Lumber Business, Kaplan, La.
- JAMES McC. FOURMY, (1916), Consulting Engineer, Hammond, La.
- A. A. FRASER, (1922), Sales Engineer, The General Fire Proofing Building Products Company, 305 Merchants Bank Bldg., Indianapolis, Ind.
- EDWARD GEORGE FREILER, (1926), Drainage Engineer, Hammond, La.
- WILLIAM BRES GREGORY, (1927), Sales Engineer, A. M. Lockett & Co., Ltd., Dallas, Texas, Office, 233 Thompson Bldg., Amarillo, Tex.
- WILL S. GUEDRY, (1925), Contractor, Associated with Alexandria Contracting Co., Inc., Box 774, Monroe, La.
- FLOYD HAMILTON, (1919), Lake Charles, La.
- JOHN LOVEJOY HENNING, (1919), 525 Kirby St., Lake Charles, La.
- SERGE POWERS HIGGINBOTHAM, (1926), Licensed Surveyor, Box 229, Baton Rouge, La.
- FREDERICK McH. HILL, (1919), Monroe, La.
- SAMUEL A. HONAKER, (1922), Civil Engineer, Box 357, Sacramento, Calif.
- GEORGE P. HOPKINS, (1922), Contractor, Gulfport, Miss.
- C. A. IVES, JR., (1922), Office Engineer, Louisiana Highway Commission, Baton Rouge, La.
- ANDREW W. JACKMAN, (1913), 6025 Freret St., New Orleans.
- CHARLES L. JACOB, (1911), 600 Kerlerec St., New Orleans.
- E. S. JARRETT, (1909), President, Jarrett-Chambers Co., Inc., Contractors, 342 Madison Ave., New York City.
- CHARLES E. JOUBERT, (1909), Assistant Engineer of Construction, La. State Highway Commission, Monroe, La.
- RAY MORRIS LAW, (1927), Resident Engineer, Pine Hills, Inc., Box 361, Pass Christian, Miss.
- JULES A. LORIO, (1921), 126 N. Genols St., New Orleans.
- L. A. LOUSTALOT, (1913), General Contractor, Hammond, La.
- R. S. McCORMICK, (1922), District Maintenance Engineer, Louisiana Highway Commission, Napoleonville, La.
- HERBERT H. McGEHEE, (1920), 432 S. Boulevard, McComb, Miss.
- RUFUS S. MANLEY, (1912), President, Texas Creosoting Co., Orange, Texas.
- ERNEST J. MEAD, (1922), Forest Engineer, 2220 North St., Beaumont, Texas.
- HENRY A. MENTZ, (1915), Consulting Engineer, Lock Drawer 929, Hammond, La.
- JULIAN DUNBAR MONETTE, (1921), Project Engineer, State Highway Department, Meridian, Miss.
- J. D. MURPHY, (1922), Civil Engineer, Mandeville, La.
- CHARLES W. OKEY, (1911), Land Department, Gesser-Goldman Cotton Co., Walnut Ridge, Ark.
- WILLIAM C. OLSEN, (1914), Consulting Engineer, Raleigh, N. C.
- GUY OSBORNE, (1913), Gable, S. C.
- BOYKIN W. PEGUES, (1907), Professor of Civil Engineering, Louisiana State University, Baton Rouge, La.
- JACK HARDEN PERKINS, (1927), Instrumentman and Assistant Resident Engineer, John F. Coleman Eng. Co., Box 361, Pass Christian, Miss.
- H. N. PHARR, (1908), Sugar Planter and Manufacturer, Olivier, La.

- H. A. PHILIPPI, (1912), Civil Engineer and Superintendent of Construction, 316 Audubon St., New Orleans.
- FREDERICK F. PILLET, (1922), Associate Professor, Civil Engineering, Louisiana State University, 613 St. Mary St., Baton Rouge, La.
- OTTOOTTO F. REISZNER, (1916), Reiszner & White, Civil Engineers, Lecompte, La.
- J. B. REYMOND, (1922), 709 Main Street, Baton Rouge, La.
- FRANK LOUIS REYNOLDS, (1919), Construction Superintendent, Todd, Robertson, and Todd Engineering Corporation, 347 Madison Ave., New York City; residence, 476 Clinton Ave., Brooklyn, N. Y.
- UNION SANDERS ROANE, (1926), with Louisiana Highway Commission, 711 Hypolite St., Baton Rouge, La.
- W. B. ROBERT, Engineer, Baton Rouge, La.
- JOHN A. SALMEN, (1911), Vice-President, Salmen Brick & Lumber Co., Ltd., Sildell, La.
- T. H. SAMPSON, (1900), Ambarwood Manufacturing Co., P. O. Box 138, Helena, Ark.
- REGINALD McC. SCHMIDT, (1915), Assistant Engineer, 4th District, Mississippi River Commission, 1023 Leontine St., New Orleans.
- HOBART D. SHAW, (1917), City Engineer and Chief Engineer, Harrison County Road Protection Commission, Gulfport, Miss.
- JOHN A. SILSBEE, (1915), Consulting Petroleum Engineer, Okmulgee, Okla.
- JULIUS SLOVENKO, (1924), 1834 S. Millard Ave., Chicago, Ill.
- T. BAKER SMITH, (1919), Houma, La.
- JOHN Y. SNYDER, (1918), Engineer, 1211 City Bank Bldg., Shreveport, La.
- KIRBY LAND SWINNEY, (1926), with Southern States Building & Construction Co., Mobile, Ala., and Biloxi, Miss. Box 797, Biloxi, Miss.
- IRA W. SYLVESTER, (1901), Consulting Engineer, Rapides Bank Bldg., Alexandria, La.
- ROGER I. TANNER, (1921), Abbeville, La.
- STEWART TICHNOR, (1922), Standard Oil Co., 602 College Ave., Baton Rouge, La.
- WM. F. TRIGGS, (1914), Operating and Maintenance Engineer, E. Fifth St., Crowley, La.
- THOS. H. TUTWILER, (1898), President and General Manager, The Memphis Street Railway Co., also President, Memphis Power and Light Co., Memphis, Tenn.
- WM. VON PHUL, (1908), Ford, Bacon & Davis, Inc., 115 Broadway, New York, N. Y.
- RICHARD CHARLES SANCHEZ WATSON, (1926), General Engineering Practice, Box 261, Hattiesburg, Miss.
- J. LESTER WHITE, (1920), Reiszner & White, Civil Engineers, Lecompte, La.
- W. S. WHITE, (C. M.), Box 44, Sulphur, La.
- A. A. WOODS, (1911), Chief Engineer, Maintenance of Ways and Structures, Southern Railway System, Lines West, 506 Southern Railway Bldg., Cincinnati, Ohio.
- D. F. WOODS, (1922), Litcher, La.

ASSOCIATE MEMBERS.

- JOHN A. ABELE, (1922), Manager, Industrial Iron Works, 1402 Whitney-Central Bldg., Locomotive and Crawling Tractor Cranes, 5215 Palmyra St., New Orleans.
- FOWLER BOYNTON BANTON, (1927), Assistant Commercial Engineer, New Orleans Public Service Inc., 201 Baronne St., New Orleans.
- RAYMOND P. BASSICH, (1923), Manager, New Orleans Blue Print & Supply Co., Inc., 826 Union St., New Orleans.
- R. H. BAUMBACH, (1911), Manager, Eugene Dietzgen Co., 316 Camp St., New Orleans.
- JOSEPH A. BRENNAN, (1920), General Contractor, The Brennan Co., 1805-97 Market St., Dallas, Texas, 1703 Hayden St., Amarillo, Texas.
- E. C. BROWN, (1915), Sales Engineer, 3820 St. Charles Ave., New Orleans.
- MICHAEL A. COOPER, (1927), Representing Utica Heater Co., 622 S. Peters St., New Orleans, La.
- LEWIS McCLELLAN DALGARN, (1921), 1517 Nashville Ave., New Orleans.
- H. W. FLETCHER, (1913), Treasurer and General Manager, The Clyde Co., Inc., 309 Magazine St., New Orleans.

- WILLIAM HENRY GARGES, (1926), Branch Manager, Chamberlain Metal Weather Strip Company, 427 Carondelet St., 5623 Milne St., New Orleans.
- GEORGE B. GIBSON, (1921), 2103 Painter St., New Orleans.
- PAUL JOSEPH GILBERT, (1925), Sewerage and Water Board, 2566 N. Rocheblave St., New Orleans.
- GEORGE J. GOVER, (1916), General Contractor, 1032-1035 Whitney Bldg., New Orleans.
- JULES GODCHAUX, (1899), 221 Godchaux Bldg., New Orleans.
- WALTER F. JAHNCKE, (1920), Secretary-Treasurer, Jahncke Service, Inc., 814 Howard Ave., New Orleans.
- RICHARD HARRISON MILLER, (1926), Manager, A. K. Miller Engineering Co., New Orleans.
- JOHN McINERNEY, (1920), Construction Superintendent, Detroit Free Press, Detroit, Mich.
- EDWARD T. MALLOY, (1920), 1211 N. Hagan Ave., New Orleans.
- JOHN J. STEADHAM, (1912), Supervisor, Bridges and Buildings, N. O. & N. E. R. R. and N. O. T. Co., 308 Newman St., Hattiesburg, Miss.
- F. W. STEVENS, (1900), Manager, New Orleans District Sales Office, Allis-Chalmers Mfg. Co., 719 Malson Blanche Bldg., New Orleans.
- WILLIAM LOUIS STEVENS, JR., (1925), with W. Horace Williams, Inc., 88, Fontainebleau Drive, New Orleans.

NON-RESIDENT ASSOCIATE MEMBER.

- LOUIS G. FLOWER, (1922), care of Layne & Bowler Co., 1510 McGowan Ave., Houston, Texas.

RESIDENT JUNIOR MEMBERS.

- HENRY HESTER RATE, (1921), Civil Engineer, Huasica Pet. Corp., Tampico, Tampas, Mexico.
- J. J. BULLING, (1915), Market Street Power House, New Orleans.
- JOHN S. BURKE, (1925), Distribution Engineering Department, New Orleans Public Service Inc., 2215 Dante St., New Orleans.
- PHILIP HOPE CAMPBELL, (1925), Office Engineer with A. M. Shaw, 6041 Perrier St., New Orleans.
- F. FOWLER CASE, (1922), Draftsman with Sewerage and Water Board, 923 Arabella St., New Orleans.
- SALVADOR DI BENEDETTO, (1925), Assistant Engineer, Orleans Levee Board, 1810 Elmire St., New Orleans.
- ROBERT JOSEPH DRUEDING, (1925), Assistant Engineer, Orleans Levee Board, 1220 Second St., New Orleans.
- DONALD C. DUPLANTIER, (1922), Assistant Engineer, Geo. J. Glover Co., Inc., 2319 Joseph St., New Orleans.
- EDWIN FRANK, (1925), 2375 Laurel St., New Orleans.
- JAMES L. FULMER, (1923), with Cumberland Telephone and Telegraph Co., 2238 General Pershing St., New Orleans.
- LOUIS KAUFMAN GOOD, (1923), Material Clerk and Labor Foreman, Box 1109 Monroe, La.
- HORATIO L. GILBERT, (1917), Surveyor, 602 Queen and Crescent Bldg., New Orleans.
- GILBERT TESSLA GRAY, (1925), with New Orleans Public Service Inc., 1321 Nashville Ave., New Orleans.
- FRANK E. HOIGHT, (1926), Draftsman, La. Highway Commission, 311 Church St., Baton Rouge, La.
- WALTER HOLLOWAY, (1923), Distribution Engineering Department, New Orleans Public Service Inc., 911 Common St., 34 Washington Ave., Ocean Springs, Miss.
- MAURICE F. HUNT, (1919), 3629 Chestnut St., New Orleans.
- S. DOUGLAS JACKSON, (1916), 326 Ward Bldg., Shreveport, La.
- JOSEPH W. JOACHIM, (1919), President and Manager of Home Ice Co., 5117 Prytanla St., New Orleans.

WILHELM EMIL KOCH, (1913), Civil Engineer, 2627 Coliseum St., New Orleans.
ROBERT JAMES KUHN, (1925), Electrolysis Engineer, New Orleans Public Service Inc.,
529 Washington Ave., New Orleans.
FRANCIS A. LANDRIEU, (1926), with Board of Commissioners, 1729 N. Rampart St.,
New Orleans.
CHARLES RENE MADUELL, (1925), with Truscon Steel Co., 5650 Ada Place, Lakeview,
New Orleans.
ROBERT VINCENT MARKEY, (1926), Draftsman, Office City Engineer, 2309 Cleveland
Ave., New Orleans.
ALBERT E. MARKS, (1925), Draftsman, Phoenix Utility Company, 3320 Palmyra St.,
New Orleans.
NATHANIEL LEVIN MARKS, (1925), Assistant City Engineer, 2017 Lowerline St.,
New Orleans.
ALEX H. McCOMISKEY, JR., (1919), 2837 Carondelet St., New Orleans.
GORDON J. McLEAN, (1924), Power Plant Equipment, New Orleans Public Service Inc.,
1544 Henry Clay Ave., New Orleans.
EDWARD M. NABERSCHNIG, JR., (1923), Works Superintendent, Southern Cotton Oil
Co., Gretna, La., 3206 St. Peters St., New Orleans.
CHARLES L. RITTENBERG, (1923), Designer, Dock Board, 2634 Marengo St., New
Orleans.
HARRY STEPHEN SALZER, (1927), Assistant Lighthouse Engineer, U. S. Lighthouse
Service, 4530 Banks St., New Orleans.
S. A. THEARD, (1920), Maintenance Engineer, Louisiana State Highway Commission,
Baton Rouge, La.

NON-RESIDENT JUNIOR MEMBERS.

G. O. ALLAIN, JR., (1916), Southern Bell Telephone Co., New Orleans.
G. C. BADGER, (1913), Superintendent of Engineering and Construction, Grinnell Co.,
of the Pacific, 601 Brannan St., San Francisco, Calif.
JACOB F. MULLER, JR., (1912), Vice-President Muller Furniture Manufacturing Co.,
Ltd., 3731 Canal St., New Orleans.
HERBERT P. NATHAN, (1913), Mechanical Engineer, Southwestern Engineering Cor-
poration, 632 Lafayette Ave., Culver City, Calif.
JAMES KILBOURNE PETRIE, (1924), Student Draftsman, La. Highway Commission,
Baton Rouge, La.

STUDENT MEMBERS.

MICHAEL CHARLES ABRAHM, 816 Cherokee St., New Orleans.
R. L. ATKINSON, 312 Audubon Blvd., New Orleans.
PERCY L. BERNSTEIN, East Beach, Gulfport, Miss.
CHARLES MILTON BROUGH, 1040 Audubon St., New Orleans.
MARTIN CARBONELL, 34 Gayarre Hall, Tulane University, New Orleans.
LESTER B. CLARK, care Bureau of Patents, Washington, D. C.
WILLIAM HENRY CREIGHTON, 1445 Henry Clay Ave., New Orleans.
LUCIEN DEYALL, 3709 Saratoga St., New Orleans.
EDWIN E. ELAM, 4330 Elba St., New Orleans.
FERNANDO ENSENAT, 34 Bienville Hall, Tulane University, New Orleans.
CHARLES JULIUS FRITCHIE, Shidell, La.
VIC. F. HARTEL, 2001 Prytanla St., New Orleans.
JOHN DETZEL HAVERKAMP, 1401 Nashville Ave., New Orleans.
WILLIAM WALLACE HAY, 834 Broadway, New Orleans.
E. C. HAWKINS, 7919 Panola St., New Orleans.
W. T. HESS, 7917 Burthe St., New Orleans.
ARTHUR M. HILL, 34 Massachusetts Ave., Suite 5, Cambridge, Mass.
EDMOND FAVRE HUGHES, 4502 S. Miro St., New Orleans.
FRANK EMIL JOHNSON, JR., 4469 Lafaye St., New Orleans.
F. LAWES KLEINPETER, 2210 Nashville Ave., New Orleans.
CHARLES LOB, 3309 St. Charles Ave., New Orleans.

LEO LEVY LOWENTRITT, John Jay Hall, Columbia University, New York City.
 E. PEUCH MADDEN, 1228 N. Rendon St., New Orleans.
 GEORGE ELMER MAY, 1533 Broadway, New Orleans.
 WILLIAM O. MASCARO, Student Engineer, 34 N. Ferry St., Schenectady, N. Y.
 LEAL C. McLEAN, 1544 Henry Clay Ave., New Orleans.
 TIM L. McNAMARA, Sellars, La.
 HAROLD E. MEADE, 119 Audubon Blvd., New Orleans.
 PAUL GRENVILLE MERRITT, JR., 1931 Gen. Pershing St., New Orleans.
 EUGENE HERBERT MIAZZA, 3424 Prytanla St., New Orleans.
 H. BLAKEMORE MYERS, JR., 7734 Belfast St., New Orleans.
 WILLIAM L. MYERS, JR., 35 Gayarre Hall, Tulane University, New Orleans.
 ARTHUR J. NAQUIN, JR., Engineer, N. O. Public Service Inc., 624 Audubon St., New Orleans.
 LAURENCE KITCHENER NELSON, 1926 N. Claiborne St., New Orleans.
 J. F. NUNEMACHER, 4915 Baccich St., New Orleans.
 WALTER K. OSER, 1108 Pine St., New Orleans.
 WILLIAM PETER OSTER, 1430 Frenchman St., New Orleans.
 PASCAL PARETI, JR., 619 Bourbon St., New Orleans.
 PHILIP FRANK PHILIPS, 2428 General Taylor St., New Orleans.
 LEON MYERS REINACH, 1805 Robert St., New Orleans.
 ASHLEY HURT ROBINSON, 1735 Palmer Ave., New Orleans.
 G. P. ROBBINS, JR., 1415 Santa Fe Bldg., Dallas, Texas.
 HARTWELL JOHN ROSSON, 1322 Elysian Fields St., New Orleans.
 RODNEY B. ROUGELOT, 2237 Napoleon Ave., New Orleans.
 HENRY B. SARGENT, 1804 State St., New Orleans.
 JOSEPH HENRY SAUCIER, 2616 Ursuline St., New Orleans.
 S. B. SCHWARTZ, Superintendent, Maginnis Cotton Mills, New Orleans.
 BEN ZION SEGALL, 4209 S. Rocheblave St., New Orleans.
 LEWIS MONROE SHELTON, 4915 Baccich St., New Orleans.
 WALTER SUMNER SIMPSON, 19 Audubon Place, New Orleans.
 DAVID STAYER, 8314 Jeannette St., New Orleans.
 HERBERT C. SWAN, 6316 Magazine St., New Orleans.
 BERNARD JAMES TORTOMASI, 2461 Burgundy St., New Orleans.
 LUCIEN T. VIVIEN, JR., 1519 N. Broad St., New Orleans.
 STEPHEN JOSEPH WALLBILLICH, 4027 Delgado Ave., New Orleans.
 JOHN MORT WALKER, JR., 6039 Prytanla St., New Orleans.
 O. P. WALKER, 5918 Chestnut St., New Orleans.
 JAMES EVANS WEED, 1525 Dufossat St., New Orleans.
 CHARLES CARROLL WIGGIN, JR., 3203 Napoleon Ave., New Orleans.
 CHARLES LAFAYETTE WRIGHT, JR., Romeville, La.

SUMMARY.

Honorary Member.....	1
Resident Members.....	235
Non-Resident Members.....	87
Associate Members.....	21
Non-Resident Associate Member.....	1
Junior Members.....	31
Non-Resident Junior Members.....	5
Student Members.....	60
Total.....	441

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Minutes of Board of Direction, November 8, 1926.

The meeting was called to order with President Hamilton in the chair and the following members present: Messrs. Lanphier, Moses, Fey and Muth.

The minutes of the previous meeting were read and approved and bills on hand were ordered paid.

Resignations of Colonel Townsend and E. R. Greenlaw were accepted with regret.

The following were dropped from the roll of the Society for failure to answer correspondence and non-payment of dues: Messrs. Bowles, Roe, Shutts, Emrich, Spence, DeGarmo, Lichtenstein, Hummel.

Names of other delinquent members were held over pending further correspondence.

There being no further business the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Society, November 8, 1926.

The meeting was called to order with President Hamilton in the chair, F. A. Muth, Secretary, and 49 members and guests present.

The minutes of the previous meeting were read and approved.

Reports were received from chairmen of the various committees present and an interesting report was made by Professor Derickson, Chairman of the Engineering Committee on Building Code Revision. In view of the fact that the building code has been passed by the Commission Council he requested that the committee be discharged. On motion, duly seconded, the committee was discharged with the thanks of the Society to that committee and to the Secretary in appreciation of the services rendered by those men.

The technical exercises of the evening consisted of a most interesting address on the "Possibilities of Light" by Mr. Sam W. Trawick. This address was followed by considerable discussion, which was enjoyed by all.

A rising vote of thanks was then tendered the speaker.

The meeting then adjourned to the usual collation.

F. A. MUTH, Secretary.

Minutes of the Meeting of the Board of Direction, December 13, 1926.

The meeting was called to order by President Hamilton, and the following members were present: Messrs. Porter, Moses, Fox, Lanphier, Fey and Muth.

The minutes of the previous meeting were read and approved and bills on hand were ordered paid.

The resignation of Mr. L. F. Troxler, Jr., was accepted with regret.

Mr. Solis Seiferth was reinstated, effective January 1, 1927.

On motion, duly seconded, the following names were ordered to ballot:

Resident Members.

Samuel T. Adams,	Peter Armand Dubus,
Sam Vernon Applewhite,	John V. Gaudet,
Ralph C. Bailey,	Paul Frost Hoots,
Clarence Nicholas Bott,	Francis Marion Ivichevich,
Sidney E. Calongne,	Roger Barton McWhorter,
John Henry Coates,	Carl G. Muench,
Wallace Campbell Drennan,	Elbert Gibbert Sandoz,
Gustave Robert Dubus,	Edwin Guy Starbuck,
Jules Frederick Dubus,	George E. Vinnedge,
	Elmer Williams.

Transfer from Student to Resident Member.

J. M. Cracroft,	Albert G. Wyler.
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Non-Resident Member.

Ray Morriss Law,	Jack Harden Perkins.
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Resident Associate Member.

Fowler Boyton Banton,	Michael A. Cooper.
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Junior Member.

Harry Stephen Salzer.

Transfer from Student to Resident Junior Member.

Salvador di Benedetto,	Philip Hope Campbell,
	Robert Joseph Drueding.

Student Members.

Martin Carbonell,	Charles Lob,
Lucien Devall,	E. Peuch Madden,
John Detzel Havekamp,	Paul Grenville Merritt, Jr.
H. Blakemore Myers, Jr.,	Rodney B. Rougelot,
William L. Myers, Jr.,	Henry B. Sargent,
Laurence Kitchener Nelson,	Walter Sumner Simpson,
William Peter Oster,	Herbert C. Swan,
Leon Myers Reinach,	Bernard James Tortomasi,
	James Evans Weed.

In view of the large number of applications for membership the Board took this opportunity of thanking the Membership Committee for its activity during the year.

There being no further business the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Society, December 13, 1926.

The meeting was called to order about 8:10 P. M., President F. P. Hamilton in the chair, F. A. Muth, Secretary, and 54 members and guests present.

The minutes of the previous meeting were read and approved.

The Chairman of the Technical Papers Committee submitted his report for the year and the Chairman took the opportunity of thanking the committee for the splendid papers secured by that committee during the year.

On motion, duly seconded, it was voted that the annual smoker be held and that the date be set for the third Saturday or January 15th, 1927.

Contents of a letter from the American Engineering Council were brought to the attention of the Society in connection with the work which has been done by the Council's Committee on "Uniform Mechanic Lien Act." On motion, duly seconded, the President was authorized to appoint a committee to study this act and to make suggestions direct to the Council in regard thereto.

The following committee was appointed: Messrs. John Riess, Chairman, S. M. Young and A. M. Lockett.

The following members were appointed tellers to serve in connection with the nomination of officers for the ensuing year: Messrs. Dusenberry, Derickson and Moses.

Nominations for officers resulted as follows:

President.	
Lanphier.....	27
Vice-President.	
Porter.....	23
Delery.....	1
Bres.....	1
Secretary.	
Muth.....	29
Robert.....	1
Treasurer.	
Moses.....	27
Derickson.....	1
Hamilton.....	1

Director to Serve Three Years.

Todd.....	23
Mann.....	1
Kerr.....	1
Vallas.....	1
Grehan.....	2
Fey.....	1

The following members were therefore declared official nominees and their names were ordered to ballot:

E. S. Lanphier, President.

John L. Porter, Vice-President.

F. A. Muth, Secretary.

W. B. Moses, Treasurer.

James M. Todd, Director to Serve Three Years.

The technical exercises of the evening consisted of an interesting address on "The Engineer As a Field Artilleryman" by Captain Ralph H. Mann. This address was illustrated with slides, charts and several instruments for artillery observations, etc.

A rising vote of thanks was then tendered the speaker.

The meeting adjourned to the collation, which was served in the Library of the Society.

F. A. MUTH, Secretary.

Minutes of the Board of Direction, Annual Meeting, January 15, 1927.

The meeting was called to order by President Hamilton and the following members were present: Messrs. Fox, Porter, Lanphier and Muth.

The minutes of the previous meeting were read and approved.

Resignations of Mr. Robert Craig, II, and Mr. H. F. Cameron were accepted with regret.

The Annual Reports of the Treasurer and Secretary were read and approved and ordered referred to the Society and later to be printed.

The following Resolution was duly seconded and carried:

RESOLUTION.

WIIEREAS, the investments of the Society are increasing to an importance not heretofore contemplated:

BE IT RESOLVED, That a standing finance committee be established to make recommendations to the Board in regard to the finances of the Society, investment of surplus funds and to have custody of securities. This committee to consist of the Vice-President, Treasurer, and one other member of the Board to be appointed by the President.

There being no further business the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Society Annual Meeting January 15, 1927.

The meeting was called to order by President Hamilton, F. A. Muth, Secretary, and 19 members present.

The minutes of the previous meeting were read and approved.

The Annual Reports of the Treasurer and Secretary were read and ordered printed in the Proceedings. The Annual Report of the Board of Direction was approved and ordered printed in the Proceedings.

Ballots were canvassed for new members, there being 70 formal ballots and 4 informal ballots, and the following members were declared elected:

Resident Members.

Samuel T. Adams,	Peter Armand Dubus,
Sam Vernon Applewhite,	John V. Gaudet,
Ralph C. Bailey,	Paul Frost Hoots,
Clarence Nicholas Bott,	Francis Marion Ivichevich,
Sidney E. Calongne,	Roger Barton McWhorter,
John Henry Coates,	Carl G. Muench,
Wallace Campbell Drennan,	Elbert Gilbert Sandoz,
Gustave Robert Dubus,	Edwin Guy Starbuck,
Jules Frederick Dubus,	George E. Vinnedge.

Transfer from Student to Resident Member.

J. M. Cracroft,	Albert G. Wyler.
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Non-Resident Member.

Ray Morris Law,	Jack Harden Perkins.
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Resident Associate Member.

Fowler Boyton Banton,	Michael A. Cooper.
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Junior Member.

Harry Stephen Salzer.

Transfer from Student to Resident Junior Member.

Salvador di Benedetto,	Philip Hope Campbell,
	Robert Joseph Drueding.

Student Members.

Martin Carbonell,	Charles Lob,
Lucien Devall,	E. Peuch Madden,
John Detzel Havekamp,	Paul Grenville Merritt, Jr.,
H. Blakemore Myers, Jr.,	Rodney B. Rougelot,
William L. Myers, Jr.,	Henry B. Sargent,
Laurence Kitchener Nelson,	Walter Sumner Simpson,
William Peter Oster,	Herbert C. Swan,
Leon Myers Reinach,	Bernard James Tortomasi,
	James Evans Weed.

Ballots were also opened for officers, there being 79 formal ballots with no informal ballots cast, and the following officers were declared elected for the ensuing year:

President, Mr. E. S. Lanphier.

Vice-President, Mr. John L. Porter.

Secretary, Mr. F. A. Muth.

Treasurer, Mr. W. B. Moses.

Member of Board to Serve Three Years, Mr. J. M. Todd.

The President took this opportunity of thanking all of the officers, committees and members of the Society for carrying out the work so successfully during the past year.

The new President, Mr. E. S. Lanphier, was then conducted to the chair. Mr. Lanphier made a few appreciative remarks in thanking the members of the Society for the honor conferred upon him.

There being no further business the meeting adjourned to a most enjoyable smoker which was held at the Chess, Checkers and Whist Club.

F. A. MUTH, Secretary.

ANNUAL REPORTS

ANNUAL REPORT OF THE BOARD OR DIRECTION.

Year 1926.

New Orleans, La., Jan. 4, 1927.

To the Members of the Louisiana Engineering Society:

Gentlemen: Your Board of Direction begs to report that during 1926 the Board held 9 regular and 2 special meetings, a total of 11 meetings, for the transaction of the Society's business.

Our Technical Papers Committee has given us a varied program of high grade papers.

Our Library Committee has done excellent work, adding a number of new books suggested by the members.

The Employment Committee had done not only excellent work but work which is much appreciated by the Board and by the members. This opportunity is taken to thank the committee for its work and to urge members and others who desire employees to call on that committee and for members of the Society wishing employment to register with that committee.

Our Membership Committee has done excellent work and deserves the commendation of the Society. The entire membership has been circularized by the President and hundreds of application blanks have been distributed in an effort to enlist in our ranks the majority of engineers in the State. These activities resulted in a total of 54 members being added to the roll due to reinstatements and elections. There have of course, been a number of resignations and adjustments, bringing the net increase to 38 members. It may be of interest to note the net increase since 1915 as follows:

1915.....	36
1916.....	26
1917.....	5
1918.....	11
1919.....	28
1920.....	11
1921.....	11
1922.....	41
1923.....	11
1924.....	30
1925.....	25
1926.....	38

Not only has the Society endeavored to add new members, but a number of those of the lower grades were transferred to higher grades,

showing their interest in participating in the Society's affairs in a larger way.

The Publication Committee Division A has given us six very excellent issues of the Proceedings. The interest in the journal indicates an increasing and wider influence due to the number of calls which are received for copies of certain issues of the Proceedings not only by members, but from outside the ranks of our Society.

The Publication Committee Division B has done especially fine work and deserves the commendation of the Society for the number of advertisements secured and maintained during the year. This committee has been especially active during the year and has added several substantial advertisements. However, all members of the Society are urged to support this committee by assisting in the securing of additional advertisements which are necessary if we are to continue the high grade of our publication. The Financial Statement shows that the Proceedings Reserve Fund has increased in the amount of \$353.57 this year.

Attention is invited to the financial condition of the Society. Our Investment Fund shows a gratifying increase of \$1000.00 set aside in the purchase of Italian Homestead stock in the sum of \$500.00 and \$500.00 in the savings account of the Canal Bank & Trust Company. The total balance is \$4,911.37. The General Reserve Fund shows a balance of \$5,471.77, and the Proceedings Reserve Fund a balance of \$1,665.54. The Treasurer's report shows a cash balance of \$1,619.71.

Re-establishment of a Geological Survey in Louisiana. Reference is made to the report of the Board for the preceding year, in which it was brought out that the establishment of a Geological Survey in this State was sought. However, the bill was not successful at the recent session of the State Legislature, and it is the hope that action can be taken on the matter with a successful outcome at the next Legislature.

Registration of Engineers. In the report of the Board for the year 1925, it was brought out that the Society was interested in the passage of additional legislation for engineers. Owing to the shortness of the time plans were not consummated in order to have a suitable bill introduced in the Legislature of 1926. Therefore in carrying out the policy of the Board the following committee has been recently appointed to draft a bill in conjunction with a committee of the Architectural Associations of this city. The following is the committee:

Colonel Marcel Garsaud, Chairman.

Mr. J. F. Coleman,

Prof. Douglas Andersno,

Prof. W. B. Gregory,

Mr. A. M. Lockett,

Prof. Donald Derickson,

Mr. B. H. Grehan.

The support of the members of the Society is requested in this important undertaking looking toward the betterment of the profession.

In conclusion, the Board wishes to thank the various committees and members of the Society for their co-operation and interest in carrying on so successfully the work of the Society.

Respectfully submitted,

F. P. HAMILTON, President.

E. S. LANPHIER, Vice-President.

F. A. MUTH, Secretary.

W. B. MOSES, Treasurer.

F. H. FOX,

J. L. PORTER,

Board of Direction.

ANNUAL REPORT OF THE SECRETARY.

Year 1926.

New Orleans, La., January 4, 1927.

To the Board of Direction, Louisiana Engineering Society, New Orleans, La.

Gentlemen: As Secretary of the Society, I herewith submit the following report for the year 1926:

During the past year the Board of Direction has held nine regular meetings and two special meetings, a total of eleven meetings; the Society has held ten regular meetings with an average attendance of 49, maximum 59, minimum 38. One of the meetings of the Society was a joint meeting with the American Society of Mechanical Engineers.

The membership shows a steady increase from year to year. This year there has been a net increase of 48 members, although there was a total of 54 elected and reinstated.

GRADE	On Roll Jan. 1, 1926	Elected	Reinstated	Transferred to	Transferred from	Dropped	Resigned	Failed to Qualify	Died	On Roll Jan. 1, 1927
Honorary Member..	1									1
Resident Members..	219	21	1	4	3	2	3	2	0	235
Non-Res. Members..	75	10	0	5	0	3	0	0	0	87
Associate Members	22	3	0	0	0	2	1	1	0	21
Non-Res. Associate..	1	0	0	0	0	0	0	0	0	1
Junior Members.....	27	2	0	3	0	0	0	1	0	31
Non-Res. Junior.....	9	0	0	0	3	0	1	0	0	5
Student Members....	49	17	0	0	6	0	0	0	0	60
Total.....	403	53	1	12	12	7	5	4	0	441

The Treasurer's report is submitted separately and shows a cash balance of \$1619.71.

During the year the investment account as submitted in the Treasurer's report stands as follows:

Total Receipts.....	\$6,424.08
Total Disbursements.....	4,804.37
	\$1,619.71
Checking account in New Orleans Bank & Trust Co.....	\$1,619.71
1—Yerxa Steves Bond.....	\$1,000.00
2—\$100.00 Second Liberty Loan.....	200.00
2—\$100.00 First Liberty Loan.....	200.00
1—\$50.00 First Liberty Loan.....	50.00
5—\$50.00 1917 Liberty Loan.....	250.00
Greater New Orleans Homestead.....	888.09
N. O. Bank & Trust Co. Savings Account.....	1,363.28
Italian Homestead.....	500.00
Canal Bank & Trust Co. Savings Account.....	500.00
	\$4,911.37

Total Cash and Investments.....\$6,531.08

It is noted from the above that during the year \$1000.00 was set aside in amounts of \$500.00 for Italian Homestead stock and \$500.00 in the savings account of the Canal Bank & Trust Company.

In addition to the above the Society still holds a share in the New Orleans Building, Louisiana State Fair, costing \$100.00.

The following technical exercises were held:

February 8.—“The Engineering Aspects of the Problems of Salt Marsh Mosquito Suppression in Louisiana,” by Mr. Percy Viosca, Jr.

March 8.—This was a joint meeting with the Local Chapter of the American Society of Mechanical Engineers. Four Vice-Presidents and the Secretary of the National Organization together with other visitors addressed the meeting.

April 12.—“Fundamental Principles of Radio Reception,” by Mr. C. A. Freitag.

May 10.—“Some Questions About Engineering Education,” by Prof. Douglas Anderson.

June 14.—“Pulverized Coal As Applied to Industrial Plants,” by Mr. W. E. Penfield.

September 13.—“Modern Methods of Cement Manufacture and the Method of Control of Concrete Mixtures,” by Mr. T. A. Mottram.

October 11.—“The Manufacture and Uses of Celotex Insulating Lumber,” by Mr. C. G. Muench.

November 8.—“The Possibilities of Light Control,” by Mr. Sam W. Trawick.

December 13.—“The Engineer as a Field Artilleryman,” by Captain Ralph H. Mann.

Attached hereto are statements showing the financial condition of the Society.

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

Respectfully submitted,

F. A. MUTH, Secretary.

FINANCIAL CONDITION OF THE SOCIETY, JANUARY 1, 1927.

Assets:

Cash on hand.....	\$1,619.71
Membership Accounts Receivable.....	1,199.00
Advertisers Accounts Receivable.....	476.86
Entrance Fees.....	109.00
Smoker Membership.....	132.00
Investments	4,911.37
	\$8,447.94

Liabilities:

Building Fund.....	\$ 151.65
Proceedings Reserve Fund.....	1,665.54
Library Fund.....	814.69
Accounts Payable.....	344.29
	2,976.17

Balance in General Fund.....\$5,471.77

General Reserve Fund.

Balance from 1914.....	\$ 165.00
Balance from 1915.....	189.75
Balance from 1916.....	377.45
Balance from 1917.....	299.49
Balance from 1918.....	27.47
	\$1,059.16
Deficit from 1919.....	62.93
	\$ 996.23
Balance from 1920.....	198.09
Balance from 1921.....	90.94
Balance from 1922.....	1,186.58
Balance from 1923.....	309.84
Balance from 1924.....	586.43
Balance from 1925.....	975.61
Balance from 1926.....	1,128.05
	\$5,471.77

Proceedings Reserve Fund.

Balance from 1915.....	\$ 112.20
Balance from 1916.....	566.13
Balance from 1917.....	568.14
Balance from 1918.....	567.52
Balance from 1919.....	41.08
	\$1,855.07
Deficit 1920.....	221.98
	\$1,633.09
Balance 1921.....	26.25
	\$1,659.34
Deficit 1922.....	301.02
	\$1,358.32
Deficit 1923.....	110.65
	\$1,247.67
Deficit 1924.....	120.26
	\$1,127.41
Balance from 1925.....	184.56
	\$1,311.97
Balance from 1926.....	353.57
	\$1,665.54

Proceedings Fund.

Revenues:	
Advertisements	\$1,228.28
Members Subscriptions.....	798.00
Proceedings Sales.....	21.30
	\$2,047.58
Expenses:	
Salary of Editor and Secretary.....	\$ 360.00
Miscellaneous Expense.....	180.00
Stenographer	114.00
Printing and Mailing.....	979.34
Losses on Cancelled Ads.....	60.67
	\$1,694.01
Gain for 1926.....	\$ 353.57

Annual Statement of the Library Fund, January 1st, 1927.

Revenues:

Balance on hand, January 1st, 1926.....	\$ 624.17
Received from General Fund.....	480.00

Total Revenues.....\$1,104.17

Expenditures:

February 8—

Miss Carrie Freret, Librarian.....	\$ 15.00
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March 8—

McGraw-Hill Book Company.....	10.15
American Society for Testing Material.....	10.40
Miss Carrie Freret, Librarian.....	15.00

April 12—

Engineering Publishing Company.....	2.00
Electric Railway Journal.....	4.00
Miss Carrie Freret, Librarian.....	15.00

May 10—

E. P. Dutton & Company.....	1.61
Miss Carrie Freret, Librarian.....	15.00

June 15—

Owen Gernon & Company.....	20.25
Miss Carrie Freret, Librarian.....	15.00

July 19—

Miss Carrie Freret, Librarian.....	30.00
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September 13—

Miss Carrie Freret, Librarian.....	15.00
Owen Gernon & Company.....	34.75

October 11—

American Society for Testing Material.....	1.20
Miss Carrie Freret, Librarian.....	15.00

November 8—

McGraw-Hill Book Company.....	10.12
Miss Carrie Freret, Librarian.....	15.00

December 13—

Engineer & Contracting Publishing Company.....	5.00
Eng. Publishing Company.....	2.00
Electrical World.....	5.00
Concrete Publishing Company.....	3.00

December 31—

Miss Carrie Freret, Librarian.....	15.00
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289.48

Balance on hand January 1st, 1927.....\$ 814.69

General Fund, Year 1926.**Revenues:**

Membership Dues.....	\$3,658.00
Smoker Account.....	365.00
Entrance Fees.....	285.00
Investment Adjustment (Increase).....	105.65
Coupons Deposited for Bonds.....	101.63
	\$4,515.28

Expenses:

Subscription to Proceedings.....	\$ 798.00
Appropriation to Library.....	480.00
Dues of Secretary.....	12.00
Salary of Secretary.....	420.00
Printing and Postage.....	304.10
Refreshments	150.85
General Expense.....	156.93
Exchange	5.20
Dues to American Engineering Council.....	271.92
Auditor	50.00
Smoker Expense	562.66
Loss due to Non-payment Dues, Ads, etc.....	175.57
	3,387.23
	\$1,128.05

Cash Account, Year 1926.**Receipts:**

1924 Dues.....	\$ 25.00
1925 Dues.....	440.00
1926 Dues.....	2,737.00
Entrance Fees.....	232.00
Smoker Membership.....	310.00
Advertisers in Proceedings.....	1,052.84
Proceedings Sales.....	21.30
Profit and Loss, A. S. M. E., etc.....	93.18
Interest on Investments.....	101.63
Total Receipts.....	\$5,012.95
Deduct Exchange Charges.....	5.20
	\$5,007.75
Add 1925 Balance.....	1,416.33
	\$6,424.08
Total Warrants This Year.....	4,804.37
Balance on Hand January 1, 1927.....	\$1,619.71

ANNUAL REPORT OF THE TREASURER, JANUARY 1st, 1927.

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

Dear Sir: As per requirements of Article No. 4 of the Constitution, I have the honor to submit the following report covering receipts and disbursements for the period of January 1st, 1926, up to January 1st, 1927.

Received from Secretary—	Deposited in New Orleans Bk. & Tr. Co.	Exchange Charged
Feb. 9, Memo 1 to 9 inclusive.....	\$1,587.69	\$ 1.60
Mar. 12, Memo 10 to 13 inclusive.....	511.91	.80
Apr. 14, Memo 14 to 15 inclusive.....	240.43	.25
May 11, Memo 16 to 19 inclusive.....	584.32	.90
June 14, Memo 20 to 22 inclusive.....	294.58	.25
July 14, Memo 23 to 24 inclusive.....	409.05	.35
Aug. 9, Memo 25 to 26 inclusive.....	268.41	.20
Sept. 14, Memo 27 to 28 inclusive.....	136.76	.20
Oct. 13, Memo 29 to 30 inclusive.....	298.75	.25
Nov. 9, Memo 31 to 33 inclusive.....	297.13	.20
Dec. 9, Memo 33A to 34 inclusive.....	101.27	.05
Dec. 21, Memo 35 to 36 inclusive.....	181.02	.15
	\$4,911.32	\$ 5.20
Int. Yerxa Steeves Bond.....	65.00	
Coupons Deposited Dec. 16, 1926.....	36.63	
		\$5,012.95
Less Exchange		5.20
		\$5,007.75
Balance on hand as per Treasurer's Report Jan. 1, 1926.....		\$1,416.33
		\$6,424.08

Disbursements from January 1st, 1926, to January 1st, 1927.

No.	Name—	Amount
January 11—		
1	Carrie Freret.....	\$ 15.00
2	Edna Doll.....	15.00
3	Engineering & Contracting.....	4.00
4	Tulane Press.....	195.13
5	F. A. Muth.....	43.50
6	R. J. Derbes, Jr.....	50.00
7	Addressograph Co.....	1.74
8	Jos. Levy & Bros.....	2.50
9	James Buckley & Co.....	2.75
10	N. O. Bank & Trust Co.....	6.00
11	W. B. Moses.....	493.02

No.	Name—	Amount
February 8—		
12	Engineering Council.....	67.98
13	Tulane Press.....	95.52
14	Carrie Freret.....	15.00
15	Edna Doll.....	15.00
16	F. A. Muth.....	46.27
17	R. G. Diamond.....	25.00
18	Boylan's Detective Agency.....	3.00
19	Pitre's Restaurant.....	16.20
March 8—		
20	McGraw-Hill Book Co.....	10.15
21	Tulane Press.....	29.50
22	American Society of Testing Materials.....	10.40
23	Boylan's Detective Agency.....	3.00
24	F. A. Muth.....	49.50
25	Edna Doll.....	15.00
26	Carrie Freret.....	15.00
27	Pitre's Restaurant.....	24.50
April 12—		
28	Tulane Press.....	295.13
29	American Engineering Council.....	67.98
30	Ole K. Olsen.....	36.75
31	Engineering Publishing Co.....	2.00
32	Electric Ry. Journal.....	4.00
33	Aarde Steno Parlor.....	30.00
34	F. A. Muth.....	44.50
35	Edna Doll.....	15.00
36	Carrie Freret.....	15.00
37	Boylan's Detective Agency.....	3.00
38	Pitre's Restaurant.....	16.00
39	Italian Homestead.....	500.00
May 10—		
40	E. P. Dutton & Co.....	1.61
41	Tulane Press.....	25.68
42	F. A. Muth.....	46.10
43	Edna Doll.....	15.00
44	Carrie Freret.....	15.00
45	H. Solzer.....	3.00
46	Boylan's Detective Agency.....	3.00
47	Pitre's Restaurant.....	16.65
48	Aarde Steno Parlor.....	10.00

Annual Reports

51

No.	Name—	Amount
June 15—		
49	Aarde Steno Parlor.....	22.00
50	R. A. Steinmayer.....	8.52
51	Owen Gernon Co.....	20.25
52	Tulane Press.....	127.47
53	Edna Doll.....	15.00
54	F. A. Muth.....	47.70
55	Carrie Freret.....	15.00
56	Boylan's Detective Agency.....	3.00
57	Pitre's Restaurant.....	18.50
58	Douglas Anderson.....	150.00
59	J. M. Hamley.....	7.00
July 19—		
60	Carrie Freret.....	30.00
61	Edna Doll.....	30.00
62	F. A. Muth.....	82.50
63	Aarde Steno Parlor.....	15.00
64	Tulane Press.....	147.18
65	American Engineering Council.....	67.98
September 13—		
66	Edna Doll.....	15.00
67	F. A. Muth.....	45.50
68	Carrie Freret.....	15.00
69	Boylan's Detective Agency.....	3.00
70	Pitre's Restaurant.....	15.75
71	Owen Gernon Co., Inc.....	34.75
72	Canal-Commercial Trust & Savings Bank.....	500.00
October 11—		
73	Aarde Steno Parlor.....	10.00
74	American Society for Testing Materials.....	1.20
75	Edna Doll.....	15.00
76	Carrie Freret.....	15.00
77	F. A. Muth.....	43.50
78	American Engineering Council.....	67.98
79	Boylan's Detective Agency.....	3.00
80	E. J. Christenberry.....	3.75
81	Pitre's Restaurant.....	14.50
November 8—		
82	Aarde Steno Parlor.....	15.00
83	McGraw-Hill Book Co.....	10.12
84	Edna Doll.....	15.00
85	F. A. Muth.....	43.60
86	Carrie Freret.....	15.00
87	Boylan's Detective Agency.....	3.00
88	Pitre's Restaurant.....	13.00

No.	Name—	Amount
December 13—		
89	Aarde Steno Parlor.....	12.00
90	Douglas Anderson.....	150.00
91	Boylan's Detective Agency.....	3.00
92	Edna Doll.....	15.00
93	Carrie Freret.....	15.00
94	F. A. Muth.....	47.00
95	E. M. S. LeBlanc.....	35.00
96	Engr. & Contract.....	5.00
97	Engineering Publishing Company.....	2.00
98	Electrical World	5.00
99	Concrete	3.00
100	Tulane Press.....	336.81
101	Pitre's Restaurant.....	15.75
		\$4,804.37

RECAPITULATION.

Total Receipts.....	\$6,424.08
Total Disbursements.....	4,804.37
	\$1,619.71
Checking account in New Orleans Bank & Trust Co.....	1,619.71
1 Yerxa Steves Bond.....	\$1,000.00
2 \$100.00 Second Liberty Loan.....	200.00
2 \$100.00 First Liberty Loan.....	200.00
1 \$ 50.00 First Liberty Loan.....	50.00
5 \$ 50.00 1917 Liberty Loan.....	250.00
Greater New Orleans Homestead.....	858.09
N. O. Bank & Trust Co. Savings Account.....	1,353.28
Italian Homestead.....	500.00
Canal Bank & Trust Co. Savings Account.....	500.00
	4,911.37
	\$6,531.08

Respectfully submitted,

WALTER B. MOSES, Treasurer.

REPORT OF THE PUBLICATION COMMITTEE—DIV. B.

January 13th, 1927.

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

Gentlemen: Your committee begs to report that through diligent effort and application we have been able to hold and maintain the forty-four advertisements during the year in the "PROCEEDINGS."

Our losses have been small. In only one case have we been unable to secure a new contract with our old reliable friends. Your committee is of the opinion that with proper attention and with the same diligence the outlook for the present year will show a better credit.

Respectfully submitted,

J. S. BARELLI,

H. E. CRUMP,

E. F. DELERY,

I. O. MALL,

JOHN T. EASTWOOD, Chairman.

REPORT OF EMPLOYMENT COMMITTEE.

December 17, 1926.

Mr. F. P. Hamilton,
408 Walnut Street,
New Orleans, La.

Dear Mr. Hamilton: No doubt you will recall your request of November 5th on the writer as Chairman of the Employment Committee of the Louisiana Engineering Society, to give you a report on the year's activities of this committee, which is composed of the writer and Mr. Rayn Bassich.

I have just received a report from Mr. Bassich and in combination with my own, I am pleased to report that during the year 1926 to December 15th, we have the following to report :

Number of applicants.....179

Number of vacancies.....107

Number of vacancies filled..... 69

Referring to the number of vacancies filled, I might mention that in many cases the applicant who secures a position does not notify us that he has secured same and there it is probable that more positions have been filled by this committee than the figures show.

As Chairman of the committee, I would like very much to recommend that all members of the Society should make full use of this committee by telephoning either to the writer or to Mr. Bassich the information of any vacancies, or sending to us anyone who is in need of a position.

Trusting that this report is satisfactory to you, I remain,

Yours truly,

R. H. BAUMBACH, Chairman.

REPORT OF THE AUDITOR.

New Orleans, La., Jan. 3rd, 1927.

To the President and Board of Directors, Louisiana Engineering Society,
New Orleans, La.

Gentlemen:

In accordance with instructions from your Mr. Muth, I have audited the books and records of your Society for the calendar year 1926, and as a result of this examination beg to submit the following Exhibits:

EXHIBIT "A"—General Balance Sheet December 31st, 1926.

EXHIBIT "B"—Detailed statement showing results of General Fund, January 1st, to December 31st, 1926.

EXHIBIT "C"—Detailed statement showing result of Proceedings Funds for the year 1926.

EXHIBIT "D"—Detailed statement of Library Fund.

EXHIBIT "E"—Statement of cash receipts and disbursements for the year 1926.

Cash.

I have made a careful check of cash receipts and vouchers for payments and found everything in order and the cash records in balance. The balance of checking account at Dec. 31, 1926, is \$1,619.71.

Accounts Receivable—Membership Dues \$1,199.00.

1923 dues unpaid.....	\$ 91.00
1924 dues unpaid.....	2.50
1925 dues unpaid.....	208.50
1926 dues unpaid.....	897.00
Total.....	\$1,199.00

Invested Reserve at December 31st, 1926.

Savings Account N. O. Bank & Trust Co.....	\$1,353.28
Savings Account Canal Bank & Trust Co.....	500.00
Total Savings Account.....	\$1,853.28
Stock Greater N. O. Homestead.....	858.09
Stock Greater Italian Homestead.....	500.00
	1,358.09
Bonds—Yerza Steves Bonds.....	\$1,000.00
First Liberty Loans.....	500.00
Second Liberty Loans.....	200.00
	1,700.00
Total.....	\$4,911.37

All funds show a very nice gain for the year 1926 and have substantially increased your Reserves.

	General Fund	Proceedings Reserve Fund	Library Fund
12/31/26	\$5,471.77	\$1,665.54	\$ 814.69
12/31/25	4,343.72	1,311.97	624.17
INCREASE	\$1,128.05	\$ 353.57	\$ 190.52

EXHIBIT "A" shows in detail all assets and liabilities as they stood on the books at December 31st, 1926, and to the best of my knowledge and belief reflects the true financial condition of your Society on that date.

Total Assets December 31, 1926.....	\$8,447.94
Total Assets December 31, 1925.....	6,704.14
TOTAL.....	\$1,743.80

It gives me pleasure to say that I have found all books and records neatly and correctly kept and that your Secretary and Treasurer deserve mention for their good work.

Respectfully yours,

LEO A. LOUBERE,
Public Accountant—Auditor.

BALANCE SHEET.

December 31st, 1926.

Assets.

Cash in Bank (Checking Account).....\$1,619.71

ACCOUNTS RECEIVABLE—

Membership Dues.....\$1,199.00

Advertisers Accounts..... 476.86

Entrance Fees..... 109.00

Smoker Membership 132.00

1,916.86

Reserve Investments.....\$4,911.37

TOTAL ASSETS.....\$8,447.94**Liabilities.**

Accounts Payable.....\$ 344.29

Proceedings Reserve Fund..... 1,665.54

Building Fund..... 151.65

Library Fund..... 814.69

Balance General Reserve Fund..... 5,471.77

TOTAL LIABILITIES.....\$8,447.94**EXHIBIT "A"****GENERAL RESERVE FUND**

As At December 31st, 1926.

Balance from 1914.....\$ 165.00

Balance from 1915..... 189.75

Balance from 1916..... 377.45

Balance from 1917..... 299.49

Balance from 1918..... 27.47

\$1,059.16

Less—1919 Deficit..... 62.93

\$ 996.23

Balance from 1920..... 198.09

Balance from 1921..... 90.94

Balance from 1922..... 1,186.58

Balance from 1923..... 309.84

Balance from 1924..... 586.43

Balance from 1925..... 975.61

Balance January 1st, 1926.....\$4,343.72

Add 1926 Gain..... 1,128.05

Balance General Reserve Fund December 31st, 1926.....\$5,471.77

GENERAL FUND, YEAR 1926.

REVENUES:

Membership Dues, 1926.....	\$3,658.00
Smoker Account.....	365.00
Entrance Fees.....	285.00
Gain on Investments (Increase in Values).....	105.65
Interest Earned on Investments.....	101.63
	4,515.28

EXPENSES:

Subscription to Proceedings.....	\$ 798.00
Appropriation to Library Fund.....	480.00
Dues of Secretary.....	12.00
Salary of Secretary.....	420.00
Printing and Postage.....	304.10
Refreshments	150.85
General Expense.....	156.93
Exchange	5.20
Dues to American Engineering Council.....	271.92
Auditor	50.00
Smoker Expense.....	562.66
Loss on Cancelled Accounts, Etc.....	175.57
	3,387.23

NET GAIN 1926.....\$1,128.05

EXHIBIT "B"

PROCEEDINGS RESERVE FUND

For Calendar Year 1926.

Balance 1915.....	\$ 112.30	
Balance 1916.....	566.13	
Balance 1917.....	568.14	
Balance 1918.....	567.52	
Balance 1919.....	41.08	
	\$1,855.07	
Deficit 1920.....	221.98	
	\$1,633.09	
Balance 1921.....	26.25	
		1,659.34
Deficit 1922.....	301.02	
Deficit 1923.....	110.65	
Deficit 1924.....	120.26	
		531.93
		\$1,127.41
Balance 1925.....		184.56
Balance January 1st, 1926.....		\$1,311.97
Add—Gain for 1926.....		353.57
Balance December 31st, 1926.....		\$1,665.54

PROCEEDINGS FUND

For the Calendar Year 1926.

REVENUES:

Advertisements	\$1,228.28
Members Subscriptions.....	798.00
Proceedings Sales.....	21.30
	\$2,047.58

EXPENSES:

Salary of Editor and Secretary.....	\$ 360.00
Miscellaneous Expense.....	180.00
Stenographer	114.00
Printing and Mailing.....	979.34
Losses on Cancelled Ads.....	60.67
	\$1,694.01
NET GAIN FOR 1926.....	\$ 353.57

EXHIBIT "C"

**ANNUAL STATEMENT OF THE LIBRARY FUND
FOR THE YEAR 1926.**

REVENUES:

Balance January 1st, 1926.....	\$ 624.17
Received from General Fund.....	480.00
	\$1,104.17

EXPENDITURES:

February 8--

Carrie Freret.....	\$ 15.00
--------------------	----------

March 8--

McGraw-Hill Book Co.....	10.15
American Society for Testing Material.....	10.40
Carrie Freret.....	\$ 15.00

April 12--

Engineer Publishing Co.....	2.00
Elec. Ry. Journal.....	4.00
Carrie Freret.....	\$ 15.00

May 10--

E. P. Dutton & Co.....	1.61
Carrie Freret.....	\$ 15.00

June 15--

Owen Gernon & Co.....	20.25
Carrie Freret.....	15.00

July 19--

Carrie Freret.....	30.00
--------------------	-------

September 13--

Carrie Freret.....	15.00
Owen Gernon & Co.....	34.75

October 11--

American Society for Testing Material.....	1.20
Carrie Freret.....	15.00

November 8--

McGraw-Hill Book Co.....	10.12
Carrie Freret.....	15.00

December 13--

Carrie Freret.....	15.00
Engineer and Contracting Pub. Co.....	5.00
Eng. Pub. Co.....	2.00
Electrical World.....	5.00
Concrete Pub. Co.....	3.00

December 31--

Carrie Freret.....	15.00
	\$ 289.48

BALANCE DECEMBER 31st, 1926.....\$ 814.69

EXHIBIT "D"

**CASH RECEIPTS AND DISBURSEMENTS FROM JANUARY 1st
TO DECEMBER 31st, 1926.**

Balance January 1st, 1926.....\$1,416.33

RECEIPTS—

1924 Dues.....	\$ 25.00
1925 Dues.....	440.00
1926 Dues.....	2,737.00
	\$3,202.00
Smoker Membership.....	\$ 310.00
Entrance Fees.....	232.00
Proceedings Advertising Receipts.....	1,052.84
Proceedings Sales.....	21.30
Bad Debts Collected.....	93.18
Interest on Investments.....	101.63

Total Receipts..... 5,012.95

\$6,429.28

DISBURSEMENTS—

1925 Accounts Payable Paid in January, 1926.....	\$ 272.63
Auditor	50.00
Smoker Expense.....	518.02
Proceedings Miscellaneous Expenses.....	165.00
Proceedings—Printing and Postage.....	212.95
Proceedings—Printing and Mailing.....	844.34
Dues American Engineer Council.....	271.92
General Expense.....	153.43
Exchange	5.20
Library Fund Expenditures.....	274.48
Salary Secretary and Editor.....	355.00
Salary of Secretary.....	385.00
Refreshments	150.85
Loss on A. S. M. E. Dinner—Paid Ole K. Olsen.....	36.75
Stenographer Service.....	114.00

Total Paid Out for Expenses, etc.....\$3,809.51

BALANCE\$2,619.71

Less—Amount set aside as reserve and invested in:

Italian Homestead Stock.....	\$ 500.00
Savings Account—Canal Bank & Trust Co.....	500.00

1,000.00

**BALANCE REMAINING IN NEW ORLEANS BANK CHECK-
ING ACCOUNT**

\$1,619.71

EXHIBIT "E"

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

FEBRUARY, 1927

“PATRONIZE OUR ADVERTISERS”

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

3
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A

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M. S. A. M. E.

J. L. DICKEY,
M. Am. Soc. C. E.
M. La. Engr. Soc.
M. S. A. M. E.

LESTER F. ALEXANDER & CO.

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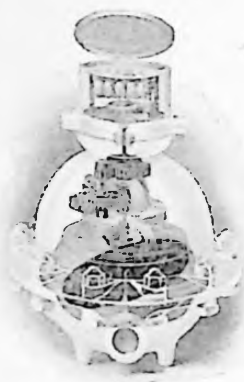
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Durable—Accurate

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PRIME MOVER

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WHITE MOTOR TRUCKS PREDOMINATE

Because of their
DURABILITY, DEPENDABILITY
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THE WHITE COMPANY

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7

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Geo. J. Glover Co., Inc.
General Contractors

*Member: American Society for Testing Materials
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*Office Buildings, Railway Buildings, Manufacturing
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We are always ready to consult with the staff engineers of plant owners and give them the benefit of our own experience, supplemented by that of the engineering forces of the leading manufacturers of plant equipment whom we represent; and we call their attention to the desirability and importance of securing the cooperation of specialists such as we are.

A. M. LOCKETT & CO., Ltd.

Contracting Mechanical Engineers and
Constructors of Complete Steam Power and Pumping Plants
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New Orleans, 919 Carondelet Bldg.

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Garlock Packing, one of the factors of Garlock Service, is a Quality controlled commodity completely manufactured in our own factories by skilled craftsmen. On account of it being the most economical Mechanical Packing Value it has been adopted as the basis of comparison for all other packing. It is universally known as The Standard Packing of the world.

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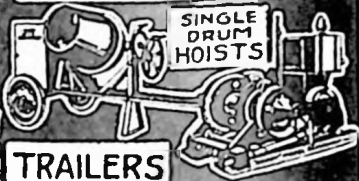
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**Electric Welding Equipment
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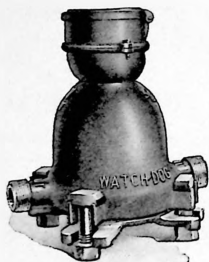
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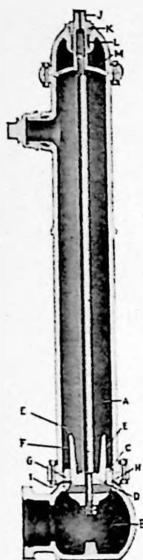
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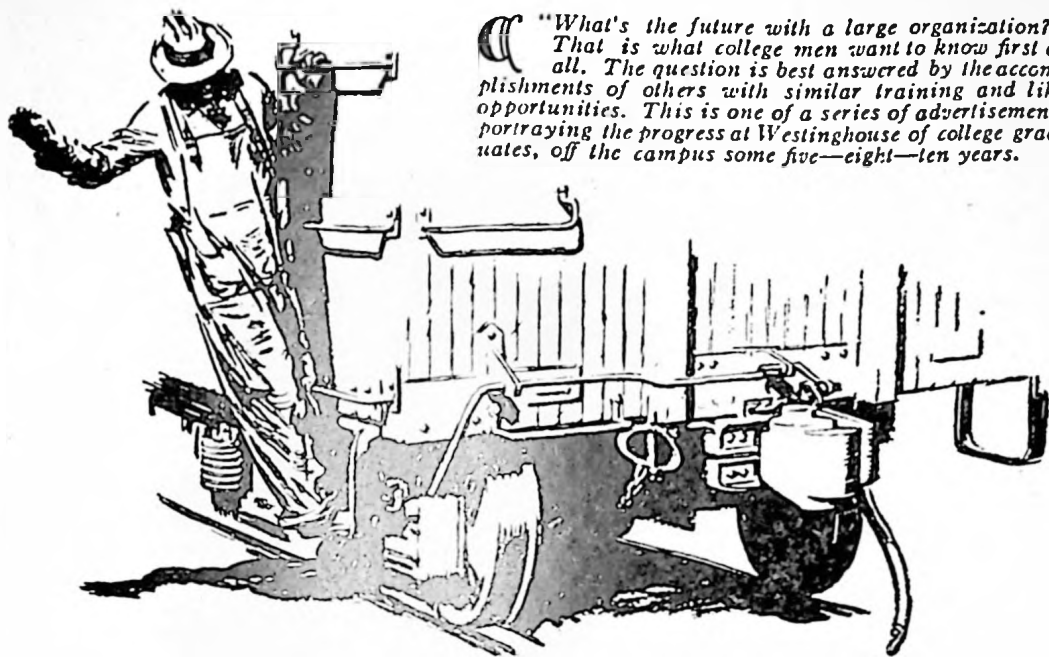
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Corliss A. Bercaw

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From the time he was old enough to delight in the shrill whistle of a locomotive, through his student days at California Institute of Technology, the most fascinating thing in the world to him was a railroad train.

It isn't just happy chance that, at 29, he is a Sales Engineer in the Transportation Division of the Westinghouse Company, at Philadelphia. And it was quite natural that Bercaw should have had an important share in the negotiations involving one of the most revolutionary transportation developments of the century — the development of the gas-electric rail car.

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When Bercaw entered the Graduate Students' Course at East Pittsburgh in May, 1919, he was fresh from college — and naval aviation. His enthusiasm for railroading was not allowed to cool—he wasn't shunted into unfamiliar lines. For thirteen months he was a student in the Railway Shops. Then for six months in the General Engineering Department he learned how to apply Westinghouse Equipment to railroad needs. It was a logical step next to the Heavy Traction Division of the Sales Department at East Pittsburgh. And two and a half years there landed him in his important work in Philadelphia.

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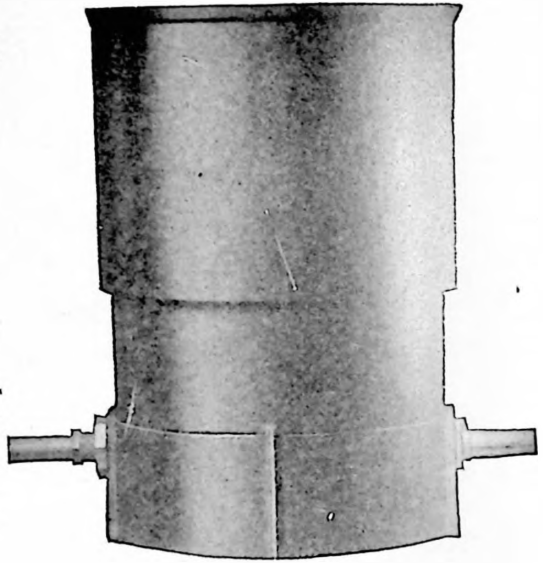
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DOUGLAS ANDERSON, Editor.

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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. XIII.

APRIL, 1927

No. 2

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EDITORIAL NOTES AND COMMENT

The Geology of the Bottom of Lake Pontchartrain. The plan of the Orleans Levee Board for the reclamation and beautification of the lake front of New Orleans has been discussed before this society and the work has progressed so rapidly that a considerable portion of the reclamation part of the project is now a reality. What was formerly swampy shore line or shallow mud flats has been filled in with solid earth and sand; artificial lakes and lagoons with connecting waterways have been constructed and when the plans for beautification shall have been put into effect New Orleans should have one of the most attractive water fronts of any city in the country.

As a preliminary to the undertaking of this important project, Professor Steinmayer was employed as geological engineer to make a complete survey of the character of the sub-aqueous strata of Lake Pontchartrain. The importance of such a survey, both to the engineers responsible for the plans and to the contractors, may be readily understood when account is taken of the enormous amount of material which was to be taken from the bottom of the lake and placed upon shore by dredges of both the hydraulic and dipper type. The knowledge to be gained from such a survey is also of great value in connection with the pile driving operations.

Professor Steinmayer opens his paper with a general discussion of the characteristics of clays, silts, sands, etc., which are likely to be found in such a locality, and then proceeds with a description of the method of securing data and the plan of studying them and co-ordinating them to maps which would seem to show the engineer and the contractor the character, the amount and the disposition of the materials with which he would have to deal throughout the area over which the project was to be developed.

The Manufacture of Portland Cement. This paper, presented by Mr. Lewis Ferguson, Manager of the Louisiana Portland Cement Co., at the March meeting of the Society, describes briefly the origin and invention of Portland cement and gives some statistics of the very rapid development of its manufacture in this country. This is followed by a description of the most approved modern method of manufacturing the cement, including the "International Wet Blending Process."

The Louisiana Portland Cement Company has just completed its new plant at the turning basin of the Industrial Canal, and this plant, according to Mr. Ferguson, is one of the best and most up-to-date anywhere in this country or abroad.

The raw material for this plant will consist largely of limestone from a quarry belonging to the company on the Tombigbee River, near St. Stephen, Ala. This material will be transported by barges from the quarry right to the doors of the mill on the Industrial Canal.

If the plans of the Outing Committee are carried out, the members of the Louisiana Engineering Society will have an opportunity to visit and inspect the plant in operation, as a very cordial invitation to do so has been extended to the Society by Mr. Ferguson.

The Engineer in Public Service. At the close of the regular technical exercises of the Society on the occasion of the February meeting, the meeting was turned over to the Louisiana Section of the American Society of Civil Engineers. Mr. J. M. Howe, retiring director of the American Society, delivered a brief address upon the subject of "The Engineer in Public Service." This address is printed elsewhere in this number of the Proceedings and it will repay any engineer to read it with great care and to give the ideas thus advanced his earnest attention.

An Honor Well Bestowed. The Louisiana Engineering Society was organized December 22, 1897, and incorporated January 1, 1898. Of the original group of men who signed the articles of incorporation as charter members, six are still members of the Society, and all of them have been important factors in its subsequent progress and development and have given years of valient service to the cause.

One of these gentlemen, Col. Sidney F. Lewis, was elected several years ago to the grade of Honorary Member, being up to this time the only Honorary Member upon the rolls of the Society.

As an expression of the esteem in which the other five gentlemen are held by their fellow members, it was voted unanimously at the last meeting to elect them to Honorary Membership.

These gentlemen are Mr. Alexander L. Black, Mr. J. Frank Coleman, Mr. Walter H. Hoffman, Mr. Gervais Lombard and Mr. Alfred F. Theard.

The records and the reputations of these gentlemen are too well known to necessitate a review here, and we would, therefore, only add by way of congratulation to them and to the

Society, the expression of our feeling that they fully measure up to the requirements for Honorary Membership, as set forth in the Constitution of the society:

“Honorary Members shall be chosen only from persons of acknowledged eminence in some branch of Engineering or of the Sciences related thereto.”

The Mississippi Flood and Flood Predictions. (Science, May 6, 1927).

“The greatest flood in Mississippi River History, now raging, gave the first grim warning of its approach eight months ago.

“The present flood began late in August when heavy rains set in, raising the waters of one or two rivers in Kansas and Oklahoma,” according to the following statement by H. C. Frankenfield, head of the division of rivers and floods of the U. S. Weather Bureau.

“In October there was flood in the Arkansas and Neosho rivers with damage of \$40,000,000, or perhaps more. Last fall, I saw mud clots on ten-foot corn stalks, out in the prairie. Then, the rains drifted eastward, over Missouri, Illinois, Ohio, Tennessee, Kentucky and the Cumberland. And all this was at a time of the year when the rivers of the Mississippi system should have normally been at their lowest level.

“We knew then that if the rains of the coming winter and spring were much above normal, we were going to have a big flood. But we can not forecast rains, and of course we could not predict the volume of the present torrent.

“Late in December rains swept Tennessee and Kentucky, and the next report was that all records were broken in the Cumberland River and there was a high flood in the Tennessee, and these are the two largest tributaries of the Ohio River. Heavy rain put the Ohio in flood in January, and then the rains became more wide-spread. During March, every tributary of the Mississippi, from the Des Moines southward and eastward, was in flood.

“There is no question that the present flood is the greatest that has ever covered the Mississippi. The flood of 1922 was the next greatest, and that of 1882 ranks third.”

"Flood warnings are sent out from the U. S. Weather Bureau every day in the year to some parts of the United States, sometimes four weeks in advance, sometimes only 18 hours. The Mississippi flood waters gather from such distant streams and have been studied so long and carefully that height and speed of the spring flood in the lower Mississippi can usually be estimated by bulletins several weeks before it sweeps through Louisiana.

"The prediction of floods is perhaps the most exact forecasting that we do," said Dr. Charles F. Marvin, chief of the U. S. Weather Bureau. "The prediction side is far ahead of the prevention measures that can be taken."

"The bureau's flood warnings are instantly heeded by the people of the region involved, even though the country at large hears very little about a flood until the water reaches an alarming state. Engineers and levee boards organize their workers and get out their equipment. The dykes are strengthened, inhabitants are notified. But along the lower Mississippi many thousands of the people are negro farmers and laborers and their families, people who often stick to their homes and trustingly climb up to the rooftops when the river menaces them, rather than escape when warned.

"Many of these river dwellers, even if they have escaped with their lives, have now seen their homes wrecked. They have lost their best chance to plant their cotton or other crops, and unless the weather favors them, they may fail to get a crop in at all.

"So long as men try to hold the Mississippi and its contributing streams within narrow bounds, so long men will have to keep close watch on the flood hazard, according to Dr. Marvin. In past ages, the river handled the problem in its own way, and made huge drainage areas. But men have built over 2,000 miles of levees to guide the river within a convenient channel. The levees are supposed to stand the strain of the torrent and they hold up remarkably, but if the water seeps in through a small leak in the wall, the rift may grow and the flood may force its way through, as it did at Dayton in the famous flood of 1913. Even though the walls of the levees are

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built higher and higher, and though they are pushed back from the river banks, even two miles in some places, the river may in emergencies demand and take more room."

Indian Mounds as Flood Refuges. (Science, May 6, 1927).

"The thousands of terror-stricken people who have taken to Indian mounds to escape the flooding Mississippi waters are showing scientists how the Indians probably used these earth-works which they built in Pre-Columbian days.

Each of these mounds, very frequent in this section, can take care of some 500 persons. Sturdily built of earth, they have resisted the onslaughts of the waters for generations, and are now pinnacles of safety to the refugees.

"The situation to-day, according to Dr. Alfred Kidder, the well-known American anthropologist, is strong evidence in favor of the theory that the mounds were originally built by the Indians a thousand years ago for this very purpose—to afford refuge from floods. Undoubtedly the Indians experienced floods of considerable magnitude and had to find some method of protecting themselves.

"In all probability," said Dr. Kidder, "it was for this purpose that they toiled for years to build these high mounds. It was a gigantic task since they had only their baskets in which to carry the tons of earth necessary to make them.

"It was at first thought that these mounds might be funeral piles like other smaller mounds in this section and in the Ohio valley, but excavations unearthed no human remains. However, post holes were discovered where the framework of buildings had evidently been erected. Baked clay was also discovered. This clay had plastered the log and twig structure of the building and was hardened into enduring form when the buildings caught fire.

"Were these mounds erected merely as high places for temples as in the case of the Aztec and Toltec pyramidal structures? was the conjecture. Against this theory arose the remote possibility that the mounds were places of refuge from floods—a theory substantiated by the present situation.

"The buildings were probably temples, altars and the habitats of chieftains," said Dr. Kidder. "In time of flood a mound could accommodate the entire tribe, most of the members of which probably lived in the inundated area."

"Pyramidal in structure, but with a flat top to permit erection of buildings, the mounds are about 150 feet in diameter and some fifty feet high. They are largely confined to the flood area of the Mississippi. A number occur, however, in areas in the valley which are not completely inundated in flood time. These were probably built later, Dr. Kidder said, in the manner of primitive peoples, after the erection of such mounds had become a custom. The funeral mounds, on the other hand, are much smaller and lower and occur frequently in both the Mississippi and Ohio valleys."

New Books. The following books have been recently added to the Library:

"Tropical Cyclones," by Dr. I. M. Cline.

"English in Business," by French and Uhler.

"Public Speaking for Business Men," by Hoffman.

PAPERS AND DISCUSSIONS

A GEOLOGICAL SURVEY OF THE SUBAQUEOUS STRATA OF LAKE PONTCHARTRAIN, NEW ORLEANS, LA.*

By R. A. STEINMAYER.

Read before the Society February 14, 1927.

INTRODUCTION.

A little more than a year ago the Board of Levee Commissioners of the Orleans Levee District, upon the recommendation of their chief engineer, Col. Marcel Garsaud, authorized him to draft plans for the redemption of the New Orleans lake front. The project is now well under way and when completed will involve the redemption and reclamation of a tract of land along the shores of Lake Pontchartrain approximately five and a half miles long and one-half mile wide, to be used for public parkways, public drives and beaches, private residences, and resort hotels.

This project, unlike similar ones in the United States, will be financed in a very unique manner, whereby the entire cost of construction and development, (\$27,000,000 00) will be met by the sale of a certain portion as private lands. The taxpayers of the community will not contribute a cent for its development and will still receive hundreds of acres of free public parkways, beaches, and lake shore drives.

AUTHORIZATION OF A GEOLOGICAL SURVEY.

As a greater portion of the area that is to be reclaimed is now submerged below lake level, all the material that will be used for fill must be borrowed by dredges from subaqueous borrow pits. Knowing the geo-physical changes in the character of each type of material, Col. Garsaud, familiar by his past engineering experiences with the numerous geological problems pertaining to the proper handling of the soils of New Orleans and its vicinity, authorized a geological survey and a geo-physical analysis to be made of the subaqueous surficial

*This paper is the result of experimental data and observation made by me, while employed in the capacity of consulting geological engineer for the Board of Levee Commissioners of the Orleans Levee District.

and sub-surface strata of Lake Pontchartrain. The purpose of this survey was to assist the engineers and contractors in their subsequent engineering operations. A threefold geological study was made of the problem in order to note: (1) The character and quantity of each type of material available for fill; (2) The unstable material liable to squeeze or subside when the load is applied; (3) The available stratum or strata capable of sustaining piling, walls, etc.

PRELIMINARY WORK FOR THE GEOLOGICAL SURVEY.

However, it becomes evident that before a proper geological study can be made of the nature of the subaqueous strata some means must be provided to bring samples from these strata to the laboratory for inspection and analysis. For this purpose a drilling contractor was instructed to drill 57 test holes to an average depth of about 60 feet below lake level. The holes were drilled in approximately a parallel series commencing from the present shore line and extending to a distance of 6500 feet out into the lake. Average distance between center lines of the test holes was about 1500 feet. As the drilling of the holes proceeded, the contractor collected samples at regular intervals of 5 feet, commencing from the top of the hole, or at every break in the formation or change in the character of the material. These samples, as collected, were immediately placed in sealed containers properly labeled with the drillers classification and notes, and then sent to the geological laboratory for further inspection.

I desire to express my appreciation, at this time, to Mr. G. A. Hesse, the drilling contractor, for the careful manner in which the samples were collected and labeled. Too often poor geological results may be traced directly to the driller because of the faulty and careless manner in which he collects and labels his samples.

INSPECTION AND ANALYSIS OF THE SAMPLES.

Upon receipt of the sealed sample jars at the laboratory, the material therein was carefully inspected, tested, analyzed, and classified into groups. The grouping was made principally on the basis of the physical properties exhibited by the material.

The physical characteristics of the material that were noted were those which related to: (1) Cohesion and Elasticity, that is hardness, tenacity, and plasticity; (2) Mass and Volume, the specific gravity; (3) Light, the optical properties of the material, also color, lustre, etc.; (4) Resistance Offered to Rupture, the tensile and compressive strength; (5) The Action of the Senses, as taste, odor, feel.

Sands were further identified with the aid of the microscope, noting the degree of fineness of the grains, the definition of the grains, whether they were rounded or angular, and the presence of foreign material and stain.

It should be noted here that air dried or mechanical water free samples are usually taken as the standard for comparison of plastic bodies, since the majority of the physical properties of the unstable soils varies with their degree of saturation. However, I felt that it would be advisable in this case to classify the material as it occurs *in situ* because 90 per cent of the subsequent engineering operations involved the handling of such material.

GROUPING OF SAMPLES.

All material was then classified according to the following groups:

- 1—Humus.
- 2—Silt.
- 3—Clay.
- 4—Gumbo.
- 5—Sand.

Silts and clays were further subdivided into groups such as humous, sandy, or shelly silts or clays, when the plastic and semi-plastic material, clays and silts, exceeded the non-plastic material, humus, sand, and shells; or silty and clayey sands when the sand was in excess of the plastic and semi-plastic material.

DEFINITIONS.

I will define my terms and give the general physical properties by which each type of material may be readily identified to avoid any misunderstanding, because often such terms as humus, silt, gumbo, etc., are misused and the meaning thereof is just as ambiguous as that unknown and undefinable sub-

stance termed muck, feared materially by the highway engineers, hurled scandalously by the politicians, and, as one engineer has stated, sometimes spread lugubriously by some college professors.

Humus is decayed vegetable mould or animal waste, usually accumulating where sewerage disposal enters a quiet body of water. It may be easily identified by its odor, slimy feel, lack of plasticity, and the presence of animal or vegetable matter.

Silt is a fine grained non-plastic material. Physically like clay, it is usually made up of a number of small microscopic particles, mostly mineral in character. Mineralogically it may consist of the same minerals found in clay but with a marked absence of colloidal material to bind the particles together or give it the property of plasticity when wet. Silt may be identified by its somewhat soft slimy feel. Furthermore the mass when wet cannot be molded with the fingers, and when it is immersed in a vessel of water it will disintegrate rapidly and the coarser grains will be slowly precipitated while some of the finer material may remain in a state of suspension for days.

“Clay is the term applied to those earthy materials occurring in nature whose prominent property is that of plasticity when wet. Physically, clay is made up of a number of small particles mostly of mineral character, ranging from grains of coarse sand to those which are of microscopic size. Mineralogically, it consists (1) of many different fragments, some of them fresh, but others in all stages of decay, and representing chemically many different compounds, such as oxides, carbonates, silicates, hydroxides, etc.; (2) of colloidal material, which might be of either organic or mineral character.”

“Types of Clay :—As to origin, clays may be roughly placed in two classes, namely (1) Residual Clays, and (2) Transported Clays. Residual clays may be defined as those clays found overlying the rock from which they were formed. It is termed residual clay, because it represents the residue of rock decay and disintegration, and its grains are more or less insoluble. Transported clays may be defined as those clays which have been carried or transported from the source of their formation by the

¹Ries: Clays, Their Occurrence, Properties, and Uses.

agencies of water and wind." Since all the clays and clay-like material near New Orleans and its vicinity are of the latter type, no further discussion will be made of residual clays.

Origin of Transported Clays:—"The general character of sedimentary clays is more or less influenced by the locality and conditions of deposition, which enables us, therefore, to divide them into the following classes: (A) Marine Clays.—This class includes those sedimentary clays deposited on the ocean bottom, where the water is quiet. They have, therefore, been laid down at some distance from the shore, since nearer the land where the water is shallower and disturbed, only coarser materials can be deposited. Beds of clay of this type may be of vast extent and great thickness, but will naturally show some variation, horizontally at least, because the different rivers flowing into the sea usually bring down different classes of material. (B) Estuarine Clays.—They represent bodies of clay laid down in the shallow arms of the sea and are consequently found in areas that are comparatively long and narrow, with the deposits showing a tendency toward basin shapes. If a strong current enters the estuary from its upper end the settling of the clay mud may be prevented, except in areas of quiet water in the recesses of the bay shore. Or, if the estuary is supplied by one stream at its head, and this of low velocity, the finer clays will be found at a point most distant from the mouth of the river. In such case we should anticipate an increase in coarseness of the clay beds or series of beds as they follow from what was formerly the old shore line up to the mouth of the former river that brought down the sediment.

"Estuarine clays often show sandy laminations and are not infrequently associated with shore marshes, due to the gradual filling up of the estuary and the growth of plants on the mud flats thus formed."

(C) "Swamp and Lake Clays:—These clays constitute a third class of deposits, which have been formed in basin-shaped depressions occupied by lakes or swamps. They represent a common type, of variable extent and thickness, but all agree in being more or less basin shaped. They not infrequently show alternating beds of clay and sand, the latter in such thin laminae

as to be readily overlooked, but causing the clay layers to split apart easily."

Most of the lake clays near New Orleans and its vicinity are of barrier beach origin, although a few of the lake clays may be of meandering stream origin, having been laid down in ox-bow lakes or lakes formed by the overflow of the Mississippi River.

"(D) Flood-plain and Terrace Clays:—Many rivers, especially in broad valleys, are bordered by a terrace or plain, there being sometimes two or more, extending like a series of shelves, or steps, up the valley side. The lowest of these is often covered by the river during periods of high water and is consequently termed the flood plain. In such times much clayey sediment is added to the surface of this flood terrace, and thus a flood plain of clay deposits may be built up."

"Owing to the fact that there is usually some current setting along over the plain when it overflowed, the finest sediments cannot settle down, except in protected spots, and consequently most terrace clays are rather sandy, with here and there pockets of fine, plastic clay. They also frequently contain more or less organic matter. Along its inner edge the terrace may be covered with a mixture of clay, sand, and stones, washed down from neighboring slopes."

In all probability it is possible to find all the representative clays of all the four mentioned classes, in the Mississippi valley, near New Orleans and its vicinity. Stratigraphically we may expect to find Flood-plain, Terrace, Swamp and Lake clays in the upper horizons. These may be found either in isolated lenses, or the two classes may be found intermingled. In the next lower horizon we would expect to find the Estuarine clays deposited either in long narrow troughs or in isolated lenses (basin-like in shape). And finally in the lowest horizon it is possible that we may find the Marine clays. The correlation and separation of these various classes would depend upon their lithological characteristics and the identification of the included fossil remains.

Clays are recognized by their argillaceous odor, fineness of grain, and plasticity. Ries has defined plasticity as the property which many bodies possess of changing form under pressure, without rupturing, which form they retain when the pressure

ceases, it being understood that the amount of pressure required, and the degree of deformation possible, will vary with the material.

Gumbo is a fine-grained tenacious clay possessing the property of high plasticity when wet and forming a rock-like mass when dry. Gumbo is generally of recent formation.

It is usually recognized by its argillaceous odor, high plasticity when wet, rock-like mass when dry, can be readily molded with the fingers when wet, and when the molded mass is pulled apart it will show a marked deformation before rupture.

Sand is the term applied to those unconsolidated fragmental aggregates or grains of mineral matter occurring in nature. Sand is always of secondary origin and represents the waste products of erosion and transportation.

Physically sand is made up of a homogeneous or heterogeneous mixture of mineral grains, either rounded or angular in shape, and varying in size from fine microscopic grains to those particles easily distinguishable by the unaided eye. The coarser aggregates are usually termed gravel.

Mineralogically, it usually consists of highly silicious, usually quartzose grains, but commercial sands and gravels contain from very small to considerable quantities of other minerals, such as mica, feldspar, calcite, hornblend, etc., in the chemical form of silicates, carbonates, and oxides. In addition there will be impurities and coloring matter which may be either of an organic or inorganic nature.

Sand is formed by the disintegration of rock accomplished by various means, and may result from the action of,—(1) water in the form of frost, rain, rivers, lakes and seas, (2) volcanos during explosive eruptions, (3) terrestrial deposits, such as wind formed deposits, (4) glacial deposits, those transported and deposited by glaciers, and to which may be added a (5th) class organic deposits, those formed by the calcareous or silicious tests of organisms.

Sand is usually recognized by its individuality of grain, rough textures, generally light color, non-metallic lustre, hardness usually between 6 and 7, absence of plasticity, not easily molded when wet, unless it contains foreign plastic material, and readiness to crumble when dry.

COMPANY - BOARD OF LEVEE COMMISSIONERS
LOCATION - DUMAINE

WELL LOG RECORD

Sheet 1 of 2

PARISH OF ORLEANS - CITY OF NEW ORLEANS
HOLE No. 6
ELEV. 36.18 C.D.

DRILLERS RECORD				GEOLOGIST'S RECORD				LOG OF FORMATION			
No. OF SAMPLE	CHARACTER OF FORMATION	DEPTH OF SAMPLE	DEPTH OF STRATA	CHARACTER OF FORMATION OF STRATUM	FEEL	PLASTICITY	REMARKS	LOG OF FORMATION	COLOR OF STRATUM	CHARACTER OF SECONDARY FORMATION	CHARACTER OF STRATUM
1	Fill	5	0					0			
2	"	10		Mixed Fill				10			
3	"	15						15			
4	Sand	20	20					20			
5	Sand	25						25			
6	"	30		Gummy Sand				30			
7	"	35		Fill	Gritty + Fine	Low	Clay + Sand equally distributed Sand very fine	35	Gray	Sandy C.D.	Clay
8	"	40						40			
9	"	45	46					46			
10	Gumbo	50		Gumbo				50			
11	"	55			Plastic	High	Gumbo Short due to fine sand Whole Shells - Pectenidae	55	Gray	-	Gumbo
12	"	60	62					62			
13	Sandy Gumbo	65		Sandy Gumbo	Plastic + Gritty	Medium	Clay + Sand 50-50 also broken shell	65	Gray	Clayey	Sand
14	"	70						70			
15	Sand	75	72	Sand	Gritty	None	Coarse Grain	72	Gray	-	Sand
16	Gumbo	80	80	Sandy Gumbo			50% Sand + 50% Gumbo in Jar	80	Gray	Sandy	Sand
17	Sand	85	82					82	Gray		Gumbo
18	"	90		Sand	Gritty	None	Medium or Coarse? XX	90	Gray	-	Sand
19	Gumbo	95	92	Gumbo Broken shell	Plastic	Very High		92	Gray	-	Gumbo
20	Sand	100	100					100			
21	"	105	108	Gumbo Broken Sand	Gritty		Medium or Coarse? Broken Shell + lignitic Material	108	Gray	-	Sand
22	Gumbo	110						110			
23	"	115		Gumbo	plastic	Medium	Soft Gumbo	115	Gray	-	Clay
24	"	120						120			
25	Sand	125	125	Dry Sand			No Record	125			
26	Gumbo	130	126					126			
27	"	135						135			
28	"	140		Gumbo	plastic	Very High	Samples 28 + 29 developed Sand cone structure XX	140	Gray	-	Gumbo
29	"	145		Sand Bells				145			
30	"	150						150			

LOGGING OF SAMPLES.

A carefully planned log sheet was kept of each test hole, giving the number, location, elevation, and depth of the hole; the driller's and geologist's classification of the samples; and a colored or plotted log graph drawn to scale showing a graphic symbol or color for each stratum, at the depth it occurred, the thickness of the stratum, and a brief description of each sample opposite the depth at which it was taken, and other information on the mechanical condition of the test hole. The log graphs are plotted on separate sheets since they are the foundation for all cross sections and facilitate the comparison and correlation of the strata.

ORIENTATION OF THE LOG GRAPHS.

All log graphs must be oriented or referred to a common plane or datum before a comparison or correlation may be made of the strata. I have taken ²Cairo Datum O. C. D. as my plane of reference for my grouping of the log graphs because this was the datum chosen by the Board's engineers in establishing their line of levels over the area in question.

STRUCTURAL CROSS SECTIONS.

In geological mapping it is not enough to show cartographically the areal distribution of the rock or soil formation but it is important, and in most cases necessary, to represent by vertical section along a particular direction the arrangement and structural relations of the rock or soil below the earth's surface. A section exhibiting this arrangement of material is called a structural cross section.

In order to definitely locate structural points at any position two cross sections at right angles to each other passing thru the location, are necessary. In investigating the area in question cross sections were taken on N-S and E-W lines, roughly parallel and normal to the present shore line, at intervals of 1000 feet. Test holes which did not fall on these co-ordinate lines were projected to the lines along the strike of the strata. The cross sections were constructed by arranging the log graphs in consecutive order so that the logs are correctly spaced as to hori-

²Zero Cairo Datum is 20.434 feet below zero Mean Gulf Level Datum.

zontal scale and oriented to a proper datum so that the tops of the log graphs represented the correct subaqueous surface features.

A careful study of the plotted structural cross sections assisted in the further identification and correlation of the subaqueous formation, inasmuch as it was possible to note by analysis and comparison the dip and strike of the strata, the thickening or thinning, the convergence or divergence of the strata or a stratum, the elimination, repetition, or presence of a stray or lenticular stratum, the sequence of deposition of strata, and a consistent horizon upon which to construct a structural sub-surface contour map.

CORRELATION.

Correlation is one of the most important, if not the most important phase, of the geological engineer's work. It is the basis for the solution of all subsequent problems in geological engineering. Where the initial correlation is erroneous none of the related problems can be correctly solved.

Correlation is the process of identifying the strata that have a mutual relation with each other. It consists essentially in dealing with the various groups of strata or material as they are noted in the graphic logs, and in working their relations from hole to hole, or from the bottom of a hole to the surface.

The correlation of the unconsolidated material commonly found in the Mississippi delta, unlike the hard rock formations, should be based primarily on the geo-physical properties of the material and secondarily on the structural arrangement of the strata. To which there may be added, where possible, correlation by formation content, such as, the water or gas content of a stratum. (This method is however open to variation and consequent error). And, above all, when a trained paleontologist is on hand, there should be a correlation by fossiliferous evidence. It has been my experience, in my study of the sands of the New Orleans area, that two sands may have the identical lithological characteristics and the same structural arrangement, but upon the identification of the fossil evidence, one sand may be of marine and the other of fluvial origin.

SUB-AQUEOUS SURFICIAL AREAL DISTRIBUTION MAP.

Upon the completion of the preliminary studies involving the inspection, classification and logging of samples, the orientation and cross sectioning of the graphic logs, and the correlation of the strata, sufficient data is now on hand to compile and construct cartographic areal distribution and structural contour maps of the sub-aqueous surficial and sub-surface strata.

A sub-aqueous surficial areal distribution map is as its name implies a cartographic reproduction, on cloth or paper, of the areal extent and type of the formation that would appear at the sub-aqueous top surface. Or, in other words, it is the process of transcribing on a map the results of a mental visualization of a bird's-eye view of the surface area with all the overlying water removed.

The graphic reproduction of the areal extent and distribution of the material is shown on the map by being drawn to scale, and the type or character of material by conventional symbols, colors or cross-hatching.

One of the important facts I wish to emphasize is the relation of the type material to the drainage and waterway canals. In every instance we find near the outlet of these canals into the lake, extensive deposits (surficial at least) of humus and silt-like material. This is especially true of the Orleans Canal, where there occur extensive deposits of humus and humus-like material, extending a distance of over 1000 feet into the lake and a half a mile on either side of the canal. This shows conclusively that in comparatively recent times, a great deal of the New Orleans sewerage was transported by the water of this canal and deposited into the lake. Between Spanish Fort and Sea Brook where there is only one canal, most of the sub-aqueous material is sand and even this is covered by a surficial deposit of humus and silt in the vicinity of the London Ave. Canal.

SUB-AQUEOUS SUB-SURFACE DISTRIBUTION MAP.

The engineers and contractors, however, are interested primarily in the sub-aqueous sub-surface strata because (1) all material that is to be used for fill quantities must be dredged from sub-aqueous borrow pits of great depth; (2) all piles, walls, etc., must penetrate a sub-surface strata capable of sustaining a load;

(3) unstable and non-resisting strata may extend to considerable depths below the sub-aqueous surface and, (4) knowing the unsatisfactory physical characteristics of the material composing a sub-surface stratum, within the limits of the borrow pit, it may be more economical to waste the material into the lake than to use it as fill quantities.

In order to assist them in their subsequent engineering operations they are supplied with additional maps showing cartographic reproductions of the character, type, and areal distribution of the material at various horizons at, above, or below the key horizon, Cairo Datum.

On the accompanying Areal Distribution Map showing the Sub-aqueous Sub-Surface Geology at Cairo Datum (See Plate 3) we find that the areal distribution of most of the material outcroppings in this plane, (O C. D.) is clay, with here and there patches of silt and silt-like material, where the surficial strata of silt-like material was excessively thick. Between Spanish Fort and Seabrook is an extensive outcrop of sand. And at the mouth of the Orleans Canal is an isolated outcrop of shells.

The colored vertical section is one of four similar sections taken on lines roughly parallel to the present shore line. Note that thruout the entire section the sub-aqueous surficial strata are made up of silt and silt-like material. Underlying the silt is an irregular clay stratum that thickens as the silt thins and vice versa, and it is eliminated entirely in the vicinity of the London Avenue Canal, where the silt is excessively thick. Underlying the entire project is a persistent sand horizon, the base of which was used as the contouring horizon.

With the compiled data and maps now on hand, the geologist has secured actual or interpolated control of every cubic inch of the material. And the entire project may now be visualized as a solid block model of conformable and unconformable strata perforated by numerous test holes and intersected by vertical and horizontal planes. The type and physical characteristics of the material composing the sub-surface strata has been previously determined by the classification and grouping of the samples taken from the test holes; the structural attitude of the beds by cross section, i. e., the intersection of the traces of the strata with

vertical planes passed normal and parallel to the cardinal direction, and the areal distribution and extent of the sub-surface strata by the sub-aqueous sub-surface maps, the intersection of the traces of the strata and horizontal planes parallel to the datum plane.

SUB-SURFACE STRUCTURAL CONTOUR MAP.

A structural contour map like a topographic map shows the undulations and configurations of a surface by lines of equal elevation, generally referred to a common datum. Usually the top or bottom of the stratum that is the most persistent, easily recognizable, and nearest the producing or supporting stratum is used as the contouring stratum. And the map is so constructed that the depth below Cairo Datum to the contoured bed is easily determined for any point in the district. A judicious use of such a map by the engineer will assist him materially in estimating, at any point in the project, the required length of a pile necessary to properly penetrate the supporting strata. And it is a factor of economic importance when the surface configurations of the supporting sub-surface strata shows great relief.

On the accompanying sub-surface structural contour map (Plate 4), contoured on the base of the gray and sand horizon, all contours are negative.

The structural contour map shows the undulations and configurations of the top of the gumbo surface, (base of the gray sand). This map was contoured negatively in order to facilitate its use in later calculations. Therefore where contours indicate elevation there exists in reality depressions and vice versa.

From a study of this map you may readily see that the surface of the contoured bed is not a plane surface with a gentle lakeward dip but rather it presents an accentuated irregular relief surface as compared to the land surface near New Orleans.

I desire to make this statement in regard to the structural contours. As you may readily see upon inspecting the map, in many cases the contours show closures or reverse dips. ideal structural conditions for the accumulation of economic deposits of oil. If these strata were all indurated and conformable upon one another, in all probability every favorable square foot of

ground would now be gushing forth liquid gold. Fortunately or unfortunately, there is no definite sequence of deposition; neither is the material indurated and our structural contours, while showing dips and reverse dips, do so only of a sand stratum overlying a plastic mass readily deformed by a slight change in pressure.

RESULTS OF THREE-FOLD GEOLOGICAL SURVEYS.

In conclusion I desire to emphasize the fact that the engineering value of the non-consolidated sub-aqueous material of Lake Pontchartrain especially when transported by water, cannot be determined solely by its geo-physical properties. This is especially true of the so-called plastic rocks, (using the term rock in its broad non-restricted sense, as an integral part of the earth's solid crust). For example, a sub-aqueous stiff clay, *in situ*, may exhibit all the desirable physical properties of good fill material, and if it were physically and economically possible to remove a mass of this material from a sub-aqueous pit A to an embankment B without any subsequent disturbance, it would thoroughly serve its purpose. If, however, this same mass from pit A is removed by the use of cutters and then transported by hydraulic means thru flumes to embankment B its physical properties have been partly or entirely altered, depending upon the degree of agitation and the amount of water, when it reaches its destination. Where we originally had a stiff clay mass *in situ*, after transportation it may be in the form of a colloidal solution. Eventually, subsequent deposition and precipitation from solution, upon evaporation, may again give us a clay-like mass, but it will never exhibit the same physical properties characteristic of the original mass. Although this final clay-like mass, precipitated from solution, may fulfill the requirements of good embankment material it has nevertheless introduced new problems to the engineer, principally the element of time.

I. THE CHARACTER AND QUANTITY OF EACH TYPE OF MATERIAL AVAILABLE FOR FILL.

Keeping in mind that the classification of the material available for engineering use is dependent on (1) the geo-physical properties exhibited by the material and (2) on the methods

used in handling the material, I have classified the character and quantity of each type of material, available for embankment quantities, within the limits of the borrow pit and dredging operations as follows: Silt and silt-like material 17 per cent, clay and clay-like material 48 per cent, sand 35 per cent, of the total mass.

Note that these estimates are based on the assumption that the limit of dredging is 40 feet below the water surface or approximately 28 feet below the top of the sub-aqueous surficial strata. If the dredging operations are extended below this depth all the additional borrow material is sand.

II. THE UNSTABLE MATERIAL LIABLE TO SQUEEZE OR SUBSIDE WHEN THE LOAD IS APPLIED.

The instability and subsidence of the various types of material occurring in the project can be readily ascertained beforehand by a study of their physical properties. It will be greatest in those materials with the lowest specific gravity and the highest degree of saturation. Care should therefor be taken not to load on material of low specific gravity, material of much higher specific gravity. If we should do so we may expect to find, in time, first a sinking of the heavier material into the lighter and finally there will occur an exchange in position of the two and the non-desirable substance with the lesser specific gravity will either be displaced laterally or come to the surface. Fortunately, however, in most cases, the true specific gravities of the type materials occurring in the sub-aqueous strata of Lake Pontchartrain do not vary by any appreciable degree from each other, and it is only when we study their apparent specific gravities that we note a marked difference. This difference, experiments have shown us, may be attributed almost entirely to the excess water, causing a swelling of the mass and in this condition each grain is regarded as being surrounded by a film of water. Since the specific gravity of water is less than that of rock, the apparent specific gravity of the combined saturated mass will be less than the true specific gravity of the porous mass.

It is my belief that about 5 per cent, and surely not more than 10 per cent, of the embankment area of the Lake Shore

PHYSICAL PROPERTIES OF THE SUBAQUEOUS MATERIAL						
TYPE OF MATERIAL	VOLUME SHRINKAGE ^{110°C} %	LOSS IN WEIGHT ^{110°C} %	POROSITY %	APPARENT SPECIFIC GRAVITY	TRUE SPECIFIC GRAVITY	COND. STRENGTH ^{110°C} lbs. per sq. in.
SILT	72.0	66.6	27.0	1.3	2.4	1007
GRAY CLAY	57.6	50.79	25.4	1.45	2.59	1735
GREEN GUNBO	23.15	24.45	22.8	2.0	2.52	920
ORANGE SANDY CLAY	16.9	21.2	29.06	2.1	2.73	590
GRAY SAND		20.6		1.9	2.66	
Porosity Formula $P = \frac{g}{s} \times 100$ V = Volume of wet test-piece g = Diff. in weight between dry & saturated test-piece or wt. in grams of oil absorbed. s = Specific Gravity of oil. True Specific Gravity Formula $sp. gr. = \frac{G}{V(100\text{percent}) - P}$ G = Actual wt. or mass of test-piece when dry. V = Apparent volume, or clay plus pore space P = per cent porosity						

PLATE V

Project is susceptible to subsidence and displacement. Those areas where subsidence is likely to occur are the areas with surficial strata of humus, humous silt, silt, and possibly soft clay.

I wish to emphasize, however, that subsidence and displacement should not be confused with shrinkage. We may find an enormous volume shrinkage of the embankment mass amounting to 30 per cent or more of the total fill quantities, due to the character of the material and its high degree of saturation.

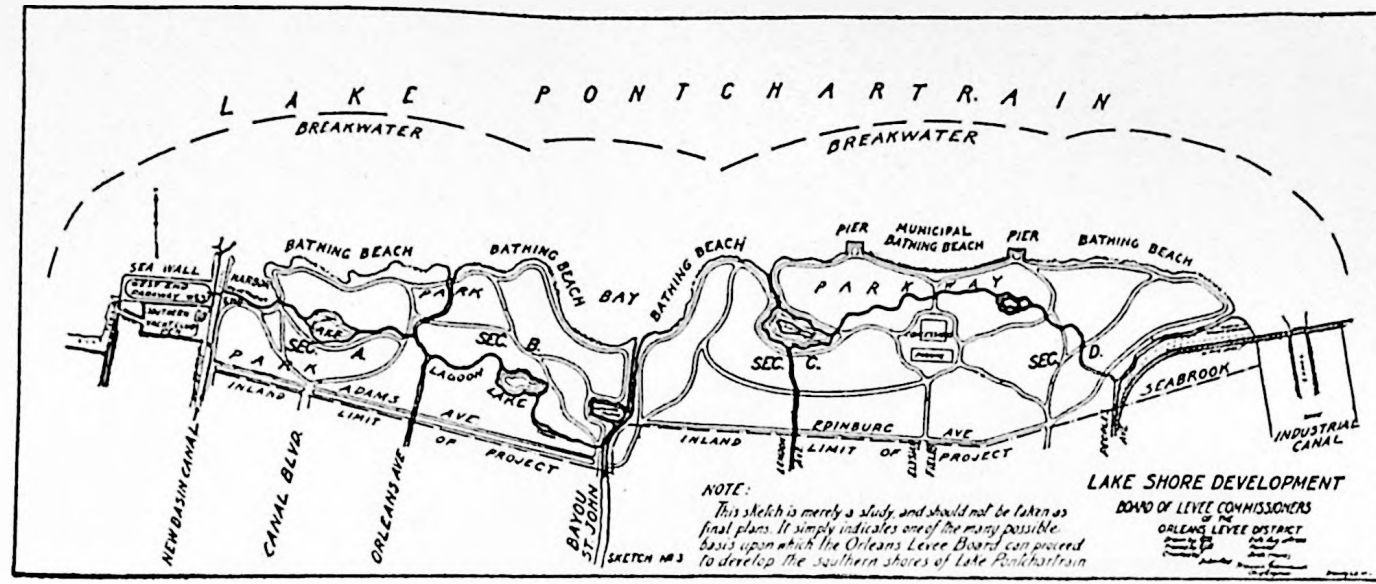
In the accompanying chart (see Plate 5) are tabulated a few of the determined physical properties of the sub-aqueous material from Lake Pontchartrain.

The volumetric method of determination of the specific gravity, while not a precise one, is sufficiently accurate for all practical purposes. The simpler and more precise method of determining the true specific gravity of clays and clay-like materials is by means of a pycnometer. The volumeter method, however, has a decided advantage when a subsequent series of high temperature tests are to be applied to an individual sample.

III. THE AVAILABLE STRATUM OR STRATA CAPABLE OF SUSTAINING PILES, WALLS, ETC.

The engineers and contractors are fortunate indeed in having such a persistent stratum of packed sand, capable of sustaining loaded piles, walls, etc., underlying their entire project within working distance of the sub-aqueous surficial surface.

I believe that I can safely predict, from the results of my geological survey, that the Board of Levee Commissioners of the Orleans Levee District will encounter no serious physical difficulties in reclaiming and redeeming the New Orleans Lake Front Parkway. In fact, this is more than a prediction, inasmuch as about eight million cubic yards of embankment material have been filled in to date. If the people of New Orleans and the State of Louisiana back them with their moral support, in less than five years from now New Orleans can boast of one of the finest Lake Front Parkways in the United States.



Discussion

THE PRESIDENT: The paper which has been read by Prof. Steinmayer has been very carefully prepared and is the result of very complete investigation and study. The paper is now open for discussion.

MR. MOSES: Prof. Steinmayer, I notice from your report that the bearing value of silt was much greater than that of sand or clay. What has that got to do with real good foundation work?

PROF. STEINMAYER: On my chart I think, my compressive strength of silt was 1007 pounds; of clay 1735 pounds. Sandy clay 590 pounds. Of course I assume that this is sand not confined. If the sand is confined, I couldn't even estimate off-hand what the bearing stress would be.

MR. YOUNG: Mr. President, I don't think there is anything I can add to the discussion. This has been a very interesting paper; it is particularly interesting to us who are building and maintaining wharves on the river front.

Some of these borings were taken right out here on the river front, and a study as to the conditions was made by Prof. Steinmayer, and the results of these studies will be very important as to what can be accomplished in the way of bank protection.

Of course, the Lake Shore development is particularly interesting to this community, because its object is to create a residential park section along the lake, which will no doubt be very desirable in the course of a few years.

I am sure we have all enjoyed this fine paper, and we hope that the charts can be published along with the paper, so as to make it more understandable, as a graphic illustration is always desirable to have.

MR. LANPHER: It has occurred to me that Mr. Kohnke might tell us something about the practical progress as occurring today.

MR. KOHNKE: Mr. President, I don't know that I can say anything more about the practical progress except to repeat the statement made by Prof. Steinmayer, that 8,000,000 cubic yards

of material is in place to date under the first contract, the first contract amounting to from ten to twelve million cubic yards.

The project as outlined on the last sketch shown will amount to something in the neighborhood of thirty-six million cubic yards of material.

If Amendment No. 14 had passed, the project would have been brought to completion with thirty-six million cubic yards. There has been a set back in that the amendment did not pass and the Orleans Levee Board has called a public meeting for tomorrow night at the City Council Chamber, to discuss the merits or demerits of the project as a whole at the present time, and a great deal depends upon the sense of the bodies who will meet there tomorrow night, as to whether the project will be carried to completion. The project will be completed as to the first fill, and the land sold or carried to completion under a subsequent renewed legislation, after the next Legislature meets, and the land developed and sold.

The contractors on the dredge project began filling, as most of you know, around Spanish Fort, and as expected from Prof. Steinmayer's studies of the subsurface area, he encountered sand and sand was what the fill consisted of.

As the work progressed toward West End, the material dredged was more of a clay nature. The contractors are now dredging and filling in the area between Bayou St. John and the London Avenue Canal, and there again considerable sand was encountered in the dredging pit, and the contractors are making very good time with that class of material. I expect within the next two or three weeks, possibly longer, the area between Bayou St. John and London Avenue will be finished and then the rest of the contract lying between London Avenue Canal and Industrial Canal will be completed.

I don't know that there is anything more I can say, except that the borings as taken by the contractors and as interpreted by Prof. Steinmayer, has been of great help I believe to the contractors bidding on this work, in that they could study Prof. Steinmayer's maps and note the different materials which were available for dredging, and the material in the area to be filled, which was the primary object of taking the borings.

The value to the Board of these boring operations and the interpretation by Prof. Steinmayer amounts to something that we cannot figure. However, I have thought as Prof. Steinmayer stated, the class of material to be dredged can be closely estimated, and the area to be filled is known insofar as the subsurface strata are concerned, and construction of any future buildings on the project can be carried out to more advantage than guessing at the foundation on which we have to build.

MR. TODD: Mr. Chairman, Prof. Steinmayer has spent considerable time and effort in connection with this paper, and I know we all enjoyed it thoroughly, and I move that we extend Prof. Steinmayer a rising vote of thanks.

CEMENT—ITS ORIGIN, PROCESSES OF MANUFACTURE AND APPLICATION TO MODERN CONSTRUCTION.

By LEWIS FERGUSON,
Manager Louisiana Portland Cement Co.

Read before the Society March 14, 1927.

Needless to say, it is a very great pleasure to be with you. We are beginning to feel much at home in the good city of New Orleans. I was going to say "our" good city, because we have come here to make it our home. It is a particular pleasure for me to address an organization of this character, an organization of engineers, men who look to the future, men who see a vision, men who can imagine how things will be as time goes on and fulfills its promises, for I, too, see a vision of this great city of the Southland, a vision that carries us into the years to come when this Southern country will be the greatest, the most prosperous part of our beloved United States. Our company is particularly impressed with the possibilities of New Orleans.

The plant of the Louisiana Portland Cement Company is being erected on the west bank of the turning basin of the Industrial Canal, within the city limits of New Orleans. This is one of the eleven mills of the International System, of which eight plants are in the United States, two in South America and one in Cuba. Our cement is manufactured in this country by all of our mills under the name of the LONE STAR brand. Many of you are doubtless familiar with the bags marked with the red star, because we are supplying this market today with LONE STAR cement from our Birmingham mill. It is interesting to note that of the eight mills in this country, five of them are Southern mills, and our original mill was of Southern origin; that is, our company began in Texas, and our Dallas and Houston mills are the parent mills of the International System.

Perhaps a bit of history about cement might be interesting to you.

Cement was known and used by the Romans. They made a cementitious material by combining volcanic ash and lime, and they used this quite extensively in the construction of many of

their buildings. Excavations in Pompeii show that one of their typical methods of construction was to build a concrete wall of this cement and veneer it with marble. They also used cement in the construction of aqueducts, and with it they built the Appian Way, as well as many other roads. These old Roman engineers knew the value of concrete roads. Here, too, in this good State of Louisiana, we will learn that concrete roads are the best roads to build. Most of the Northern States have already learned that. North Carolina has recently built an extensive concrete road system, and this has done much for the wonderful development of that State. Alabama and Mississippi have built more concrete roads than we have in this State. The Highway engineers of Louisiana are sure to get in step with the march of progress before long.

The art of cement making seems to have been lost with the decline of the Romans, and it was re-discovered in quite an interesting way. A man by the name of Smeaton took a contract to build the Eddystone Lighthouse, which occupied a very exposed position in the English Channel, and guaranteed that he would build that lighthouse to withstand the storms which occurred every season. Lime mortar was the only bonding material Smeaton knew, and he determined he would make his mortar as strong as possible. He thought this would be accomplished by burning lime rock which contained the smallest amount of impurities. Much to his surprise, he discovered that instead of getting an increasing strength as he eliminated the foreign material, which happened to be shale, he actually got less strength. He then reversed his position and used more and more shale with his lime rock until he was using the rock just as it was coming from the quarry. What he really obtained was a natural cement. The Eddystone Lighthouse was built with this material, and it stood for many years as a monument to the re-discovery of cement. Smeaton probably didn't appreciate what he had done, for it wasn't until about thirty-five years later that his investigations were published.

In 1824, a very clever man named Joseph Aspdin, who had apparently been making quite extensive investigations, was granted a patent in England for the manufacture of Portland

cement. Portland cement, according to Aspdin, was a combination of argillaceous and calcareous materials, proportioned in a definite and predetermined manner, and our present standard definition of Portland cement, if I can recall it, doesn't read far from Aspdin's patent. Portland cement, as we know, is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion an intimate and properly proportioned mixture of argillaceous and calcareous materials, with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum.

Aspdin knew a good many things about making cement. For instance, he knew he could get a more intimate contact of his raw materials if he ground and mixed them in the wet state. As years went on cement manufacturers thought to improve on Aspdin's method of preparing the raw materials by mixing them in the dry. Now modern practice is coming to recognize the cleverness of Aspdin in combining the raw rock in a wet state. Our own International System adopted, a good many years ago, the wet method, and developed what we call the "International Wet Blending Process." After mixing his raw materials into a paste or slurry, Aspdin allowed the water to evaporate and form cubes. Then he put the cubes into a vertical kiln, making alternate layers of coal. This he ignited and burned the slurry cubes until he had produced cement clinker. Of course, Aspdin got an non-uniform product. Some of the clinker was overburned, some of it was not sufficiently burned. Nevertheless, he got a wonderful material, and many remarkable buildings have been built of it. Aspdin was not only a clever scientist, but he also showed cleverness as a salesman when he named his material "Portland Cement." The word "Portland" he adopted from a very well known and popular limestone quarried on the Isle of Portland, and used for most of the fine buildings being erected at that time.

Aspdin's cement, when mixed with water and allowed to set, resembled quite closely the texture, color and general appearance of the Portland limestone that was so popular.

When the manufacture of Portland cement began in the United States, we encountered the same conditions that are

always met when we try to compete with European manufactured products. We must compete with their low wages. This is just what American cement manufacturers are having to do today, and in addition to these low wages, the very low cost of transportation makes competition still more severe. The way our early cement manufacturers solved the problem was to devise improved types of machinery. Instead of the old vertical kiln which, up to that time had been used by the European engineers, we developed the rotary kiln. This is a horizontal tube, rotating on rollers, and in it the raw material is burned. This device decreased the labor cost, and gave a much improved and uniform product. The first rotary kiln was used in this country in 1899, and at first, only a comparatively few barrels of cement were made in the United States, but the rapid growth of the industry is a typically American phenomenon.

From 1895 to 1913, production of Portland cement increased from less than a million barrels at the beginning of the period to ninety-two million. In 1926, approximately, one hundred and sixty-five million barrels were manufactured in this country. As the cement industry grew, manufacturing machinery was greatly improved. Today, of course, our mills are far superior in efficiency and quality of product than were the mills which existed in the early days. The plant we have constructed in New Orleans is, we believe, the best one that was ever built anywhere, either in this country or Europe.

The major portion of our raw material will be obtained from our quarry on the Tombigbee River near St. Stephens, Ala. There, we have an excellent deposit of limestone. This deposit is soft and easily brought to a state of extreme fineness. The chemical composition is just what is needed to make a cement of the superior quality that we expect to obtain from our New Orleans mill.

Rock will be brought on barges down the Tombigbee River, past Mobile, across the Mississippi Sound, through Lake Pontchartrain to the Industrial Canal, and our barges will land at our wharf on the turning basin. Our location on the canal

enables us to deliver our raw materials as economically as possible, considering the distance it must be transported.

Deck barges holding approximately one thousand tons each will be used, and we will have a 500 H. P. Diesel tug of light draft, in order to enable us to navigate the rather shoal waters existing in places in the Mississippi Sound.

Unloading from the barges will be done with a stiff leg derrick carrying a three-yard clam shell bucket. The rock will be delivered into hoppers at the end of the storage shed. From the hoppers the material will be transported by a belt conveyor, either directly to the raw grinding department or into our rock storage, which has a capacity of approximately twenty thousand tons. This is about one month's supply.

The raw material is analyzed by our chemist as soon as it is delivered to the storage shed, and he knows immediately what the chemical composition of it is in the various parts of the storage pile. With this knowledge, he is able to direct the mill forces from which places they should obtain the raw material, in order to get exactly the proper chemical composition.

An overhead crane, traveling the full length of the storage shed, enables us to take rock from any place desired, and place it on the conveyor belt by which it is carried to the raw grinding department.

The first raw grinding unit is the Kominuter. This is a short, horizontal tube revolving on its axis. In it are steel balls, and as the Kominuter revolves, the steel balls, through impact, thoroughly crush and grind the material.

At this point, clay and water are also admitted, the clay being fed from a trough by two Ferris wheel type feeders. In the Kominuter the limestone and clay, mixed with the water, are thoroughly ground into a thin paste which is called slurry. It is apparent that two materials can be mixed wet more intimately, and can be more evenly combined than two dry powders, no matter how much they are mixed. While the wet process involves extra cost in that the water must be subsequently evaporated before the burning can take place, nevertheless we feel that our wet process is well warranted, be-

cause of the superior quality of cement produced. The introduction of water into the Kominuter constitutes the wet method of cement manufacture.

The Kominuters grind the material sufficiently fine to pass through a quarter-inch screen, and then it goes into what we call a Trix mill. This little machine acts much like a cream separator. It separates the fine material from the coarser, and the coarse particles are conveyed back again into the Kominuter for further grinding, while the fines are led to the second grinding unit. This unit we call a tube mill. It is also a horizontal cylinder revolving on its axis, and in it are slugs of approximately an inch in diameter. Here the grinding and stirring of the slurry is continued, and it is still further reduced in fineness until about 96% of it will pass through a 200 mesh sieve. From the tube mill the slurry is carried into large concrete tanks, and here is introduced one of the most advanced steps that has been taken in the manufacture of Portland cement. We call it the "International Wet Blending Process."

There are three of these tanks in the New Orleans mill. As the slurry passes from the tube mills to one of these three tanks it is chemically analyzed. The chemist, therefore, knows exactly what the chemical composition is of the slurry in each tank, and can direct the filling of the tanks so as to give very closely the chemical composition desired.

When the tanks are filled, the chemist knows exactly what is in each one of them, because constant tests are made of the contents. In order that the material in the tanks is uniform, it is constantly agitated, by both vertical and horizontal agitators. From these three tanks the slurry is conducted to two other concrete tanks. The piping is so arranged that these secondary or storage tanks can be filled from any one, or all of the first three tanks. By this means the slurry is blended to a degree of uniformity which is not possible with any other method. This system we term the "International Wet Blending Process."

Our company is a thorough believer in the fact that the quality of cement is absolutely dependent upon uniformity of the slurry entering the kiln. The chemist must get the exact

chemical proportions, and that he does is shown by the fact that we are able to control the chemical composition of our raw material within one-tenth of one per cent. This method of control has enabled our company to manufacture a Portland cement exceeding standard specifications by a considerable margin.

From the storage basins the slurry is fed into the kilns. The speed of feeding is regulated by the man in charge of the burning, who stands in front of the kiln at the opposite end from which the slurry is fed.

In the New Orleans plant there are two kilns, and in them the burning takes place. The kilns are 219 feet long, and vary from 9 feet to 8 feet in diameter. They are lined with fire brick through most of the length, on account of very high temperatures which occur. The end of the kiln into which the slurry is fed is at a slightly higher elevation than the discharge end, as the axis of the kiln is sloped about three-eighths of an inch to the foot. The kiln rotates slowly on rollers. The first action on the slurry, after being introduced into the kiln, is the evaporation of the moisture, and it is changed from a wet paste into a dry powder, then continues to progress toward the lower end of the kiln as it rotates.

The fuel we will use here is powdered coal, and it is introduced in the lower or front end of the kiln in the form of a blast combined with air. Before the coal can be properly burned, it must be ground to a fine powder, and thoroughly dried. In our New Orleans plant this drying is done in bins placed in front of the kilns. The temperature in the burning zone of the kiln, which is that part toward the front, is about 2700°. As the gases pass back through the kiln, some of their heat is absorbed, but even so, the temperatures in the stacks are very high.

Immediately after leaving the kiln the gasses pass into an enlarged compartment, known as the dust chamber. Here the velocity is reduced, and any dust carried by the gases is deposited in the bottom of the chamber from which it is conveyed back to the slurry feed. From the dust chamber a vent

leads to a chimney. There are two of these—220 feet high, built of concrete.

As the clinker runs out of the front end of the kiln it drops through a hood into another inclined cylinder called the cooler. Air is passed over the hot clinkers, in order to reduce its temperature. This air, of course, becomes hot, and we use it to dry the coal. The coolers discharge the clinker into a conveyor, located at right angles to the coolers. This conveyor consists of a steel trough supported by pendulums, which give it a slow forward and rapid backward motion. This jumps the clinker along to another hopper from which it is carried up to a conveyor in the top of the building, and then across the clinker silos.

There are two of these silos for the storage of clinker, and a third one beside the other two for the storage of gypsum. From these silos the clinker is carried overhead to our finish grinding department. Here a small amount of gypsum is always added, in order to control the setting qualities of the cement. The addition of gypsum, however, must be limited, for you will remember that the specifications for Portland cement permit only 2% sulphuric anhydride.

Both our raw grinding department and our finish grinding department are in the same building. In the raw end, however, our preliminary grinding, as we have seen, is done in the Komnuter. In the finish department a different kind of machine is employed in the first step. Here we use what is known as a Hercules mill. This mill is operated by a vertical shaft to which is attached grinding stones. These break down the clinker until about 62% will pass through a 200 mesh sieve. In the side of the mill are screens, and as the material becomes fine enough, it passes through these screens and goes to tube mills for the finish grinding. This is the same kind of an apparatus that we used for grinding our limestone and clay, and in it the cement is pulverized to the requisite fineness. The standard specifications require that 78% of the cement shall pass a 200 mesh sieve. It is our practice to grind cement considerably finer than that.

From the tube mill the cement is transported into concrete storage bins. There are eight of these large tanks or silos, and they have a combined capacity of about 120,000 barrels. These silos enable us to store cement for a sufficient period to permit a twenty-eight day test, and they also permit us to take off the peaks in the heavy shipping season. That is, we can run our mill at a uniform rate of production, even though the amount of cement shipped varies.

From the silos the cement is conveyed to the packing department where it is packed into bags by means of Bates packing machines. These bags are mostly cotton, and they are filled in an interesting way. The bags are first tied at the top with a wire tie, and then are filled through a valve in the bottom of the sack. The bag is pushed over a spout on the packing machine, which enters through this valve, and then the operator, by means of a lever, starts the filling. When the bag is filled with the right amount of cement, the flow is automatically cut off, and the bag drops on to a conveyor, which leads directly into cars, which have been spotted on the loading track beside the pack house.

In our New Orleans plant we will also have a belt conveyor leading to the wharf, in order to enable us to load into vessels or barges.

The entire mill is arranged to eliminate dust. Neatness, order and cleanliness will be noticeable everywhere. In fact, our plant will be so clean that we will be able to serve luncheons in what is usually the most dusty part of a cement mill.

We hope to have the pleasure of a visit from this organization when the plant is in operation. After we have shown you through the mill, we will serve you a luncheon and prove our prediction of cleanliness.

Discussion

THE PRESIDENT: The City of New Orleans has been fortunate in securing this large industrial plant for the manufacture of cement, and our Society is indeed fortunate in having Mr. Ferguson address us.

The members will remember with pleasure that Mr. Ferguson has stated it is his intention to invite the Society down to inspect

the plant, and to lunch, and the Outing Committee will take that matter up and advise you a little later.

Now the paper is open for discussion. I thought it would be well if Mr. Young would make a few remarks on the operation of the Canal for industrial purposes, and particularly as it pertains to the development of the cement plant.

MR. YOUNG: I feel that it is hardly necessary for me to say much about the operation of the Canal or its industries to an audience of this character, as I believe that most of the gentlemen here are more or less familiar with the situation.

Of course, the Canal was built primarily for the purpose of providing water front sites for industries which require such facilities. No doubt the immediate and urgent demand for sites for shipbuilding plants which were going to build ships for the World War hurried up the building of the Canal.

While there are many people in New Orleans who are perhaps impatient for progress in the development of the Canal as a location for industries, it should be realized that this development will necessarily be gradual. We feel, however, that industries will come—in fact, we already have some, such as this very important one which has been described in such an interesting way this evening. The Lukens Steel Company's fabricating plant was the first industry to locate on the Canal. It has a 99-year lease on approximately fifteen acres. The Louisiana Portland Cement Company has a similar lease on about fourteen acres.

There are also several other industries located on the Canal. On the north side of the turning basin, the Warrior Cement Corporation has a site for storing cement which will be shipped in from Alabama in bulk and stored in bins for local distribution. Several smaller industries have short term leases on sites along the Canal near Lake Pontchartrain.

As structures erected on these sites will be exempt from taxation for fifteen years from 1921, and as lands belonging to the Dock Board are not subject to taxation, the Inner-Harbor Navigation Canal, as a location for industries requiring water frontage, is surrounded by very favorable conditions. We feel that we are fully justified in the belief that the Canal will eventually become a very important industrial center.

On account of its location with respect to commercial centers and also due to a practically constant water level and to other advantages, it is almost inevitable that the Canal is destined to be the location for future extension of port facilities. It is nearer to business centers than are points on the river either above or below existing wharves. Of course, that does not mean that the wharves along the river will not always be just as important as they are now. There are still a few available spaces on the river bank for additional wharves, and these undoubtedly will be occupied as the demands of commerce increase and as the port grows.

As you know, we already have one wharf on the Canal, and the steamship people seem to like this wharf very much. They like to come into the Canal. They have a constant water level there, and the wharf itself seems to suit them; it seems to be laid out conveniently for them; it has railroad tracks on the water side apron, and also in the rear, and ample storage space within the shed.

It is also true that it is easier and less expensive to build wharves on the Canal than on the river. This is due to the fact that we do not have to contend with great variations of water level, and consequent high levees and unstable banks.

It is very gratifying to hear Mr. Ferguson say that his company is well pleased with their location on the Canal. Of course, in the beginning it must have seemed rather bad to them; it had been recently filled by hydraulic dredging and there was plenty of mud. However, that situation is improving all the while and no doubt will soon be entirely satisfactory.

There is ample space along the Canal for a large number of industries, and due to what appears to us to be very favorable conditions, we believe that industries will seek these locations. We expect to see New Orleans grow to be very much more important as a manufacturing center than it has been up to this time, and we expect to see many of these industries located on the Canal.

I would just like to say, while I am on my feet, that I believe that this is one of the most interesting papers that has been presented before this Society. The cement industry is of interest

to perhaps the majority of engineers, and this interest has been greatly stimulated by the educational work of the Portland Cement Association and by interesting papers such as we have had the privilege of enjoying this evening.

PROFESSOR GREGORY: I would like to ask Mr. Ferguson how soon they expect to turn out cement from this plant.

MR. FERGUSON: Our plant is almost completed now and so far as the mill itself is concerned, we will be in position to manufacture cement probably within a month. However, the opening of the quarry will take somewhat longer than we thought, and our schedule now indicates that we will be able to ship cement from our plant and supply customers about the latter part of June, or perhaps the early part of July of this year.

MR. KLORER: There is something I think should be brought to the members' attention, which was touched on very briefly in Mr. Ferguson's address, and that is the effect of the competition of foreign cement with local products.

The City of New Orleans, through the Commission Council, has recognized that situation and also recognized her new industries coming within the City of New Orleans, within the city limits, and that this industry should be given the full measure of co-operation and encouragement, and accordingly, the Commission Council called a session and agreed that on future specifications for city work, we would ask that our cement specifications provide that Portland cement should be used. After hearing Mr. Ferguson explain the superior quality of cement manufactured at this plant, I now feel that we should have said the product should have been limited to the cement manufactured by the Louisiana Portland Cement Company.

MR. FERGUSON: Mr. Klorer, I thank you very much for those kind remarks. What you say indicates that our faith in New Orleans has been justified. We believe that you really mean to carry out the slogan: "What New Orleans makes, makes New Orleans."

We are greatly encouraged by such a statement, as Mr. Klorer, with his tremendous influence, has just made. We believe that not only is he encouraging us, but that men in positions of authority, such as he occupies, are really taking a broad,

patriotic view of the situation in keeping money circulating at home instead of sending it abroad.

MR. DUSENBURY: I understand you located originally in New Orleans on account of the shells available here. Is it simply for economical reasons that you are not using the shells as expected, or is it that you can make better cement out of other material?

MR. FERGUSON: We have sufficient quantity of shells, and it is quite possible that we may use some of them, but a comprehensive study of all the factors involved led us to believe that it would be better to begin at least with the limestone quarry, which we have on the Tombigbee River.

MR. BLACK: One matter I should like to ask about particularly is the blending clinker. You keep it in storage, I believe?

MR. FERGUSON: There is the opportunity, of course, of blending clinkers, but it is better not to have to. We get a very uniform quality of clinkers from our kilns.

MR. BLACK: Sufficiently uniform?

MR. FERGUSON: Yes.

A MEMBER: I would like to ask Mr. Ferguson whether in the tube mill the grinding is done solely by those iron slugs?

MR. FERGUSON: The grinding of the slurry is first done in the Kominuter, which has balls in it, and after being ground quite fine, passes to the tube mill to finish the grinding.

A MEMBER: But it is the iron slug that do the grinding?

MR. FERGUSON: Yes.

MR. CRACROFT: What causes the clinker to come down in the kiln—is it gravity action?

MR. FERGUSON: The kiln is on an incline about three-eighth of an inch to a foot. The kiln revolves, and as it revolves the clinker rolls down hill.

MR. CRACROFT: Is it possible to use any other fuel than coal?

MR. FERGUSON: Yes, gas or oil.

MR. KERR: I would like to suggest that we give a rising vote of thanks to Mr. Ferguson for his very interesting paper.

THE ENGINEER IN PUBLIC SERVICE

By J. M. HOWE,

Retiring Director A. S. C. E.

Presented before the Society February 14, 1927.

I want to stress tonight the need for engineers on our unpaid honorary governing boards, and to urge you to do your duty to the public by giving freely of your time and skill.

In the pioneer days, the engineer, perforce, spent most of his time in the wilderness, building railroads, dams, power plants, levees, etc., and he could not be of much use to others than his immediate employers. Now, since the settlement of the country, and the pushing back of the frontier into Northern Canada and the mountains of Mexico, most engineering work is carried on close to civilization. In fact, engineers today, instead of developing new country, are mostly employed with the problems of congestion of population:—Water supply and waste disposal for our teeming cities, transportation congestion, city planning and power distribution. Even when the engineer is occupied away from populous centers, the telephone and automobile keep him in contact with the people who are handling the many political and civic problems in which he, as a citizen, should be interested.

This change in the engineer's living condition should and will have a marked effect on his future life. There is no longer any reason why he should not now take his rightful place among the moulders of public opinion and political policies.

There are excellent reasons for having engineers on most of the various political, semi-political and financial boards that control the varied activities of modern life. The Chamber of Commerce Committees on Highways, Drainage and Navigation should have engineering members, Universities can use them on their Boards of Regents, Eleemosynary Institutions on their Boards of Trustees, and the various State and City Boards would undoubtedly be much helped by engineering members. The engineer, by the very type of his training, makes an excellent balance wheel on a board composed largely of lawyers and financial leaders. The engineer, instinctively looks through the

superficialities and delves after fundamental facts. His very persistence in getting down to the essentials is sometimes disconcerting to his fellow board members, but the clearer view that he frequently furnishes of a construction or operating problem is usually appreciated by his non-technical confreres.

That is all very well, you may say, but what will it cost me? Frankly, it costs a lot of time and frequently some personal criticism of your official acts. The latter being particularly true, when the board is largely composed of politically ambitious members, who let their better judgment be swayed by popular clamor.

What will you get in return for such service? In direct remuneration not a picayune, or let us say, a penny; as it is more than probable that even here in New Orleans a picayune would have considerable pecuniary value on account of its rarity. You will gain much, however, in self gratification for duty well done and in the knowledge that you have done your part in payment of your debt to society. And we do owe a debt to society. Those of us who have been reasonably successful, could not possibly have succeeded, had it not been for the unselfish work of our forbears.

There are returns that come to the engineer which, while giving no direct compensation, do eventually pay him for his sacrifices. One of these is publicity. As a professional man, publicity should be obtained only in an indirect manner. The young lawyer attempts to get acquaintanceship and publicity through political activity. The engineer can gain much more tangible results through public service. The fact that he is a member of a certain board or committee gives him dignified prominence that is in itself excellent advertising. The association of men of affairs not only broadens his conception of business methods, but puts him in intimate touch with the type of men from whom he can expect employment or recommendation to others.

How are you to get this kind of work? Not by direct application, of course. The appointments to worth while places are the result of satisfactory service in minor positions. Committee activities in your local social or professional clubs, membership

in your neighborhood improvement society, participation in church, Y. M. C. A. or Boy Scout affairs. Through any or all of these channels come the men who are selected for the more important positions. Faithful, conscientious, disinterested service in a small way will inevitably lead to the more responsible places. The world is full of slackers and self-seekers, and when a man is found who really does the work without hope of reward, he is certain to be honored by the men with whom he has worked.

Just one more word: While there will undoubtedly be compensations to the faithful worker, he must go into the work without thought of such compensation. If the prospect of social or financial advancement is the paramount reason for taking such a position, the worker is doomed to disappointment. The public and one's fellow workers are quick to detect the motives of the self-seeker. Better keep plodding along in the old track of individualism if you cannot unselfishly and wholeheartedly do the work without thought of remuneration. The remuneration will come to you, both in the good will and thanks of fellow citizens, and also in the more tangible results that you will receive from the confidence inspired by your unselfish work.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Minutes of the Board of Direction, October 14, 1927.

The meeting was called to order with President Lanphier in the chair and the following members were present: Messrs. Todd, Moses, Fox, Hamilton and Muth.

The Minutes of the previous meeting were read and approved and the bills on hand were ordered paid.

Communication from the Assistant Secretary of the American Society of Mechanical Engineers was read and on motion, duly seconded, the Secretary was instructed to make reply indicating the present degree of co-operation existing between the Local Sections of the National Engineering Societies and the Louisiana Engineering Society.

The grade of membership of Mr. F. L. Aleus was transferred from Non-Resident to Resident.

The resignation of Mr. J. D. Monette was accepted with regret.

The request was approved to have the Engineering Library of the University of Missouri placed on the mailing list to receive the Proceedings.

There being no further business the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Society, February 14, 1927.

The meeting was called to order about 8:15 P. M. with President Lanphier in the chair, F. A. Muth, Secretary, and 84 members and guests present.

The Minutes of the previous meeting were read and approved.

List of standing committees appointed for the year was read to the Society.

The report of the Chairman of the Employment Committee for the month of January was also read.

The technical exercises of the evening consisted of a most interesting address on "The Sub-aqueous Strata of the New Orleans Side of the Lake Pontchartrain," by Prof. R. A. Steinmayer. This address was illustrated with lantern slides and charts, and was followed by an interesting discussion.

A rising vote of thanks was then tendered the speaker.

The meeting was then turned over to the Louisiana Section of the American Society of Civil Engineers.

Mr. James M. Howe, Retiring Director, related some of the experiences of the Board and discussed in a general way some of the affairs of the American Society of Civil Engineering. He then delivered a most

interesting address on "The Engineer in Public Life." This address was enjoyed by all.

The meeting then adjourned to the collation.

F. A. MUTH, Secretary.

Minutes of the Board of Direction, March 14, 1927.

The meeting was called to order by President Lauphler, and the following members were present: Messrs. Hamilton, Porter, Fox, Fey, Moses, Todd and Muth.

The Minutes of the previous meeting were read and approved and bills on hand were ordered paid.

Letter of February 24th from Colonel Marcel Garsaud, Chairman, Registration Committee of Engineers and Architects, requesting an appropriation of \$50.00 for the work of the committee, was read, and the appropriation was authorized.

On motion, duly seconded, it was voted that a committee be appointed to take care of repairs to the library room during the summer recess of the Society. Estimate is to be submitted to the Board as soon as practicable. The following are members of the committee: John L. Porter, Chairman; F. A. Muth, Jas. M. Todd.

Mr. F. P. Hamilton presented to the Board a letter from the Executive Secretary of the American Engineering Council relative to raising of a fund for the Public Works Bill. Mr. Hamilton was authorized to reply to the letter as he sees fit, and indicating that the opinion of the Board is that the Society is subscribing to the American Engineering Council, etc., all of the funds that the Society can afford, and that it does not feel that it can make any further financial efforts.

Report of the Finance Committee dated March 8th was read and received and ordered filed, the matters listed therein being taken up and voted on unanimously seriatim as follows:

On motion of Walter B. Moses, Treasurer, seconded by James M. Todd, it was voted that the Treasurer be bonded in the sum of \$5,000.00, the premium for which is to be paid for by the Society, and that he be authorized to retain the key to the safety deposit box as recommended in the Finance Committee's report.

It was also voted that \$1,000 from the checking account be invested in two New Orleans homesteads, placing \$500.00 in each.

The Finance Committee reports that securities in the safety deposit box were listed, which list was in accordance with the Treasurer's annual report.

The membership of Mr. J. D. Murphy was changed to Resident Member.

The membership of Mr. F. P. Elizardi was changed from Resident to Non-Resident.

Mr. W. H. Rhodes was reinstated as of January 1st as a Resident Member.

There being no further business the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Society, March 14, 1927.

The meeting was called to order about 8:25 P. M. with Mr. E. S. Lanphier, President, in the chair, and F. A. Muth, Secretary, and 107 members and guests present.

On motion, duly seconded, the reading of the minutes of the previous meeting was dispensed with.

The technical exercises of the evening consisted of a most interesting address on the "Louisiana Portland Cement Plant at New Orleans" by Mr. Lewis R. Ferguson, Manager. This address was illustrated with diagrams and slides.

Interesting discussion followed the address, and the speaker was then tendered a rising vote of thanks.

The President announced that arrangements had already been made tentatively to hold an outing at the plant of the Louisiana Portland Cement Company upon the invitation of Mr. Ferguson, and that the Outing Committee would look after the details of the outing when the plant is in commission.

The meeting then adjourned to the collation which was served in the library of the Society.

F. A. MUTH, Secretary.

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

APRIL, 1927

"PATRONIZE OUR ADVERTISERS"

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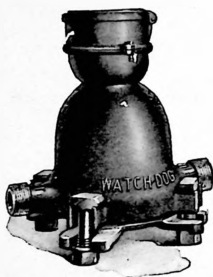
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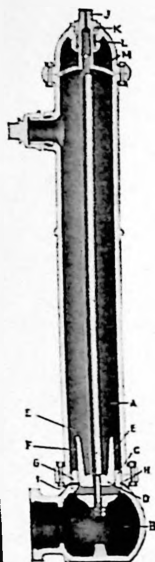
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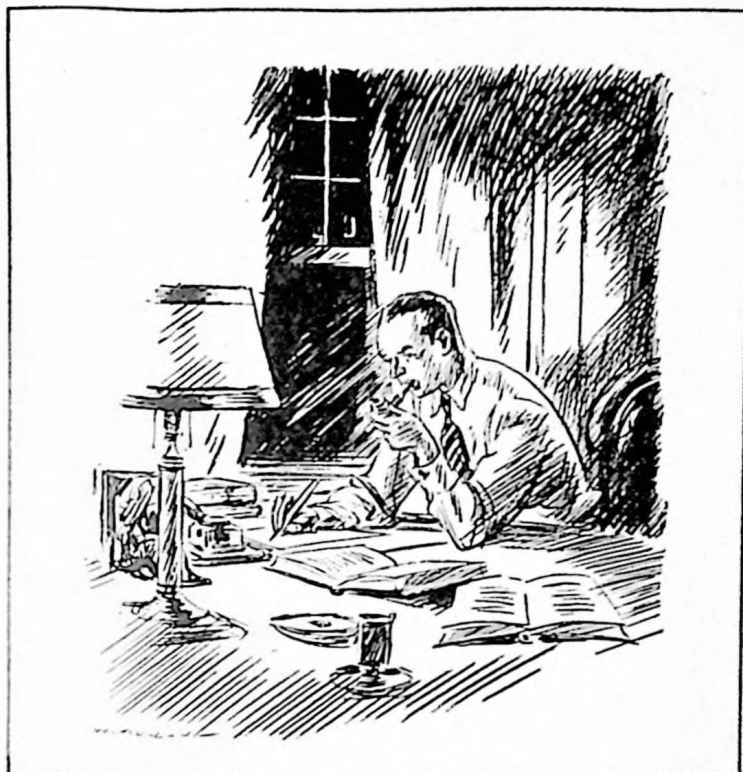
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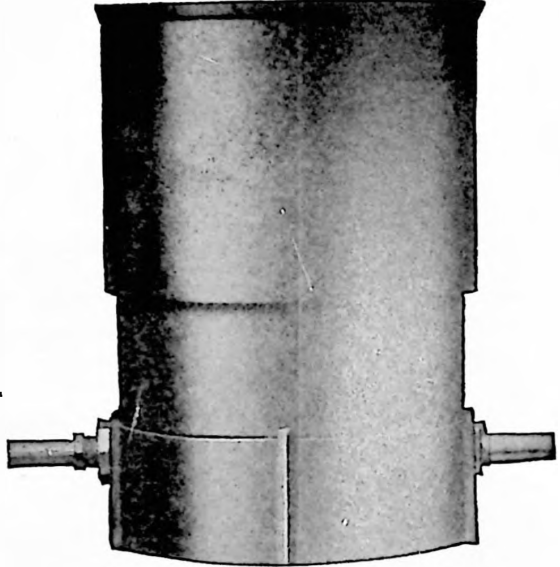
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DOUGLAS ANDERSON, Editor.

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All business communications should be addressed to F. A. Muth, Secretary,
7705 Willow Street, New Orleans, La.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XIII.

JUNE, 1927

No. 3

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EDITORIAL NOTES AND COMMENT

The Mechanical Design of Creosoting Plants. Mr. Nelson's paper on Creosoting Plants, published elsewhere in this issue of the Proceedings, is a plea for the recognition of the important part the mechanical engineer should be accorded in the design of such plants.

By way of illustration he calls attention in the early part of the paper to a case in which a mechanical engineer was called in to try and improve the design and operation of the vacuum system. With the old system from 45 to 60 minutes were required to attain a vacuum of 24 inches; after the system had been redesigned by the mechanical engineer it became a simple matter to attain a vacuum of 26 inches in a period of 8 minutes.

The paper then proceeds to discuss in detail all of the more important features of the creosoting equipment which call for the services of the mechanical engineer in their design. These are the cylinder or retort, the boiler, the pumps, the air compressor, the vacuum system, the piping and the recording and measuring system.

Survey of Traffic Signals in New Orleans. The National Conference on Street and Highway Safety has emphasized the necessity of uniformity in traffic signals and markings. American Engineering Council is making a national survey as to the practices now prevailing in order to develop standards for signals and markings for city streets along somewhat the same lines as already adopted for Federal Aid Highways.

In order to carry out this purpose, data are being secured from about 150 cities. New Orleans was one of the cities selected and the co-operation of the Louisiana Engineering Society was requested. The matter was turned over to the Committee on Civic Industrial Affairs, of which Professor Derickson is chairman. After a very considerable amount of painstaking work on the part of Professor Derickson the report was gotten into shape and presented to the Society for transmittal to American Engineering Council.

One cannot but hope that the work will be pushed to the end that there may be adopted a uniform set of standard signals for the use of cities. The diversity of signals, as well as the rules and regulations governing their use, is very confusing to the motorist on tour, and opens the possibility of serious accidents under certain conditions.

"A Near Century of Public Service in New Orleans." Under the above title the New Orleans Public Service, Inc., has just issued a very attractive booklet, under the authorship of Dr. Hugh Mercer Blain. It is the story of the origins and progressive development of the gas, electric light and street railway services in this city. These industries, while apparently having to do principally with the material phases of the city's progress, have a romantic story of their own, and Dr. Blain is to be congratulated on the interesting way in which he has developed the story. In addition the mechanical make-up of the book is very excellent and the illustrations are well chosen and most interesting.

The writer of this notice was greatly interested in that portion of the book which deals with the early history of electric lighting, as he knew Mr. Oswald personally as well as some of

the other men who formed the original Edison Electric Illuminating Company. This same period marked the beginnings of the teaching of Engineering in Tulane University, the first course being one in Electrical Engineering. The Electrical Engineering Department of Tulane has a number of old machines and pieces of apparatus which date from the very earliest attempts to furnish electric service to the City of New Orleans. In those early days there was also an attempt made to establish the industry of manufacturing electric machinery, and a company was formed which operated for a number of years and turned out a good line of electric motors.

We extend our congratulations to New Orleans Public Service, Inc., and to Dr. Blain, for his very interesting contribution to the industrial history of New Orleans.

"Much Ado About Nothing." Under this somewhat catchy title, *Research Narratives*, that excellent little monthly leaflet, published by Engineering Foundation, furnishes us with some interesting and instructive information which, with acknowledgments, we take the liberty of reprinting here, upon:—

Usefulness of Vacus

"Strive as they may, scientists have been unable to attain a vacuum wherein a cubic inch includes fewer molecules than there are people in the world. Even so they have succeeded in removing 99.999,999,999 per cent of the gas. In other words, only one of every 10,000,000,000 molecules remains; yet there are 40,000,000,000 molecules in every cubic inch; the population of the earth is estimated at less than 2,000,000,000.

"Across the broad girth of America, from New York to San Francisco, a four days' journey by train, thirty hours by swiftest airplane, imagine a great belt of fine sand a thousand feet, or nearly a fifth of a mile, in width and ten feet deep. Its length, from coast to coast, would be more than 2500 miles. Then imagine it suddenly reduced to a line, so slender as to be almost invisible, just two grains broad and one grain deep.

"That is a graphic illustration of how completely a modern Coolidge x-ray tube is exhausted of air by the high efficiency Langmuir condensation pump in the

research laboratory of the General Electric Company. The great beach with its millions of millions of grains of sand is symbolic of the cubic inch of air at atmospheric pressure, if each of its molecules were enlarged to the size of a grain of sand one one-hundredth of an inch in diameter, and the line two grains broad and one grain deep represents the almost complete vacuum obtainable with the Langmuir pump. No vacuum known to science is absolutely complete.

"The swiftness with which the air is drawn out is equally marvelous. If from a vessel holding a quart there were removed a million molecules a second, it would take 750,000,000 years to remove practically all of its air; but the Langmuir pump accomplishes this in just two seconds.

"It can hardly be said of a vacuum, as we know it, that 'There's nothing in it.' Materially, there are countless thousands of molecules in the highest vacuum attained; there is also endless interest and utility. In fact, the American public is paying more than a million dollars a week for glass-contained vacua.

"Ability to create even partial vacua in enclosed spaces has been of great use. It has made possible suction pumps, thermometers, incandescent electric lamps and many improved physical and chemical processes, and has increased the efficiency of steam engines and turbines.

"At night we see largely by the aid of vacuum lamps. By means of other vacuum lamps (x-ray tubes) we can also see through opaque bodies. Our transcontinental wired telephony is possible through vacuum tubes, which, in various forms, also permit our radio broadcasting and radio reception from the most remote stations. One of the latest achievements of science, the transmission of photographs by wire or wireless, incorporates still another vacuum tube, the photo-electric cell.

"The workman who keeps his drink hot or cold in a thermos bottle is indebted to Sir James Dewar's application of the vacuum, but the scientist is still more indebted to it. Our steam-power plants, including turbines, also owe their success to vacua.

"Vacua are of different types. For the steam turbine, a rough vacuum is sufficient—about an inch of

mercury. Incandescent lamps formerly required the best vacua available, but there are now other commercial vacua necessarily quite superior, such as those for x-ray and radio tubes, and for the newly developed cathode ray tube.

“So much for vacua within enclosed spaces on our planet. We have reached the point where only one of ten billion molecules remains in as perfect a vacuum as we have attained; but Nature has far outdistanced us. It appears evident, or at least probable, that the condition which humans call vacuum is the natural state throughout the vastness of interstellar space, and some of the stars—millions of miles in diameter and countless millions of miles away from us—are but superheated gases, less dense than the residual gas in the most nearly perfect vacuum tube we know.”

PAPERS AND DISCUSSIONS

CREOSOTING PLANT DESIGN

By B. S. NELSON.

Read Before the Society, April 11, 1927.

It seems characteristic of Americans that we waste our splendid national resources because of their bountiful supply, until we wake up and realize that they are practically gone; and perhaps no more startling example exists than in the case of our lumber supply, particularly pine and cypress, in this region.

One has merely to compare the prices and quality of lumber today with those of, say, fifteen years ago, or, to consider the fact that a large lumber mill in Mississippi is importing fir sawlogs from the Pacific Coast, or, that we can buy at local lumber yards foreign lumber, such as fir, redwood, and spruce, at prices comparing favorably with our native woods, to realize the truth of this statement.

As lumber prices advance, it behooves us as a matter of simple economy, aside from the conservation features, to either make our lumber last longer in service by some preserving process, or to use, where practicable, other more permanent substitute building materials, as is done in Europe, where lumber is scarce and expensive.

Economic laws will no doubt strike an automatic balance between the two alternatives, but it is evident that wood preservation is of greater importance now than ever before, and will continue to grow.

Under atmospheric conditions in the South, wood preservation is synonymous with the creosoting processes.

It is not the purpose of this paper to enter the discussion of the chemistry or operation of such plants, which would be the province of the creosoting engineer, but rather to treat of the problems of engineering design entering such a plant, and to enter a plea that the design of these plants be considered as a problem for a mechanical engineer.

In the course of a wide range of engineering work, the writer has often been amazed at seeing a level headed business man or banker making machinery purchases involving many thousands of dollars, on the most superficial advice, when the services of a competent mechanical engineer would show savings in investment or operation many times the cost of such advice.

There is some extenuation for such procedure in the case of creosoting plants because wood preserving is a highly specialized industry, and treating engineers have felt that they know their own business best,—but the fact remains that the various mechanical elements of these plants obey the same physical laws and are susceptible to analysis on the same basis, when used in creosoting as when used for other purposes.

We could point to several cases where the application of experience gained from other sources was beneficial in selecting treating plant equipment, but the most conspicuous case was in the design of the condenser equipment.

The vacuum cycle is one of the most important elements in wood treatment, not only as regards the product, but also as regards loss in plant operating time per charge of timber.

The vacuum equipment was one of the sorest trials of the operator, because it was difficult to reach the desired vacuum and took a long time to reach it.

Analysis of current equipment showed that its selection had ignored several important necessities for ordinary vacuum production, as well as some special factors peculiar to the service.

Convinced that our reasoning was sound, we prevailed upon a plant owner to install a system designed to handle the features mentioned; in this plant the old system required something like 45 minutes to 1 hour or longer to attain 24" vacuum—the new system reached 26" vacuum in 8 minutes, resulting in a large time saving in tieup of expensive equipment, as well as giving better results.

The factors entering the design of a treating plant should be considered as affecting the following—

First cost,
Time cost,
Labor cost,
Fuel cost.

Inasmuch as a complete treating plant comprises not only the mechanical equipment proper, but also a large outlay for storage yards, tracks, trams and tanks, as well as a stock of timber and a selling organization, the cost of the mechanical end of a plant requiring a total investment of several hundred thousand dollars would probably range between one-fourth and one-third of the total investment.

It is therefore good economy to use substantial equipment which will involve a minimum of lost time due to break-downs and repairs.

The other factors usually must be considered in relation to the particular plant conditions. Some plants do not aim at continuous operation, hence, operating time per cycle is of less relative importance than for the 24-hour plant.

Some plants have waste material and planing mill trash for fuel, while others purchase all of their fuel, but in general, fuel of any kind is sufficiently valuable to warrant consideration of its conservation.

Similarly, it is desirable in practically every case to consider the labor for operation, and to so plan the equipment as to reduce labor to a minimum.

Any commercial plant in this territory is apt to have specifications calling for one or the other of two standard methods of treatment, namely, the full cell process and the empty cell, or Rueping process; so it is customary in designing such plants to provide mechanical equipment suitable for either process. Similarly, the majority of the plants treat not only green timber, piling, and poles, but also air-dried material, usually in the shape of cross-ties.

The treatment of green material necessitates preliminary drying, usually termed "steaming," and as this steaming constitutes the largest demand on the boiler capacity, the advisa-

bility of motor-driven plant equipment is to the writer's mind somewhat dubious excepting for plants which treat a preponderance of air-dried material.

The principal elements entering the design of a treating plant are: The treating cylinder or retort, the boilers, the pumps, air compressor, vacuum system, pipework, and the recording and measuring system, usually termed the gageboard and measuring tanks.

The design of cylinders has been considerably improved in recent years, but considering the more or less standard requirements for these cylinders, there is room for improvement in the way of standardized specifications as to construction details and working pressure.

The size of the treating cylinder in diameter and length fixes the requirements of the rest of the plant. The length of the cylinder is usually fixed by the length or multiple of lengths of materials to be treated, whereas, the diameter has apparently been a matter of personal preference on the part of the plant designer, as cylinders are found ranging all the way from 5 feet diameter to 9 feet 6 inches diameter. The present tendency seems to standardize on a cylinder about 8 feet diameter, because this affords an economical section in which it is possible to use a standard gage track, as well as to use trams of proportions which keep the waste area or voids down to a reasonable percentage.

It is quite common to build cylinders with longitudinal seams butt-strapped, and we believe the very best construction to consist of the so-called gun-barrel type cylinder, where both longitudinal and girt seams are butt-strapped, and rivet heads countersunk. This has the advantage of reducing waste space above the tram rails, as well as making impossible the obstruction of the cylinder due to cars or lumber catching on projecting plates or rivet heads, and the additional cost of this construction is comparatively small.

The cylinder joints and plate thicknesses are figured from conventional steel plate and rivet formulae, and the usual specification calls for a cylinder built to stand 250 pounds working pressure, 375 pounds test pressure, safety factor 4.

The type of riveted joint has been improved by applying experience from modern boiler construction, such as reaming rivet holes to exact size and alignment; and the use of welding instead of caulking has further eliminated leaks.

The design of cylinder doors is one that has improved considerably, in that leakage at the joints where the door closes was often a serious problem. A favorite design consists of a hinged door with the joint bearing surface of the door a homogeneous part of the head itself.

An alternative door arrangement occasionally found consists in eliminating the hinges and suspending the door vertically from a small derrick fastened to the cylinder. Such a door can be swung around the side of the cylinder with less end clearance, which is sometimes a desirable point, particularly in climates necessitating enclosing the cylinder inside of the building.

A frequent source of annoyance in cylinders is leakage in the cylinder joints and in the pipe connections to the cylinder, due to the fact that because of the length of the cylinder and the large temperature range during each treating cycle, the expansion and contraction are very considerable. The most satisfactory solution of this problem has been worked out by anchoring the cylinder firmly at its central point on a substantial masonry foundation and providing expansion rollers on the rest of the supporting piers. This has cured the leaks in the cylinder proper. Similarly, by taking all pipe connections off at midpoint or anchor point of the cylinder, the expansion strains in the pipe work can be eliminated. This is usually done by providing a large dome at the mid point of the cylinder, to which a majority of the pipe connections are made.

Another source of annoyance was the leakage in the heating coils of the cylinder for a similar reason. This may be prevented by using heating coils of the double pipe form with ends welded into a steel header box, making a coil without any screwed connections whatever, and then having the steam inlet and outlet connections to this header box pass thru a stuffing box in the bottom cylinder wall.

The boiler plant is an important consideration in a treating plant, and there is considerable diversity of opinion as to the best type of boiler, whether water tube or fire tube, also as to the proper capacity boiler for a given plant. There is likewise no standardization in the way of boiler steam pressure. In our opinion, the water tube boiler has many advantages for creosote plant work because of its quick steaming to meet peak demands, and its somewhat better efficiency, and particularly when of the type where the tubes are vertical or nearly so, there is less tendency for deposit on the heating surfaces from burning wood refuse.

As to the steam pressure, while high pressure steam is not essential around a creosote plant, the operation of the mechanical equipment is more economical with fairly high steam pressure, and we believe that a pressure of 150 pounds is advisable.

Most plants have some waste fuel available, in which case the boiler furnace must be designed for composite service. Where coal is burned, the use of some form of hand-stoker or shaking grate is desirable, as it not only improves firing conditions but enables quicker steaming to meet peak demands.

The three important creosote oil pumps in a treating plant are the general service pump, which is used for transferring oil principally from the storage to the measuring tanks, or similar low pressure work around the plant; the filling pump, which is used for transferring large quantities of oil quickly, the principal use being for filling the cylinder during the Rueping process, and the pressure pump, which is used for injecting the requisite oil into the timber at the proper time during the cycle.

The general service pump presents no particular difficulties, as the service is not severe, but to eliminate trouble with disk valves, we find that the ball valve pump for this service is very satisfactory.

The filling pump has been a source of considerable annoyance. The usual pump is a very large duplex reciprocating pump, and as the service of filling the cylinder requires the transfer of a large quantity of oil in the shortest possible time, there is a natural temptation to run this pump far beyond its proper speed, and combined with the fact that these pumps

usually have a head on the suction, the result has been a great deal of trouble with the valves, it being typical of such a condition that a reciprocating pump is apt to knock its valve seat or valves out when run at high speed with pressure on the suction.

A recent development and a very satisfactory substitution has been the use of a centrifugal pump, either motor driven or steam turbine driven, the latter being particularly desirable, as it permits varying the capacity and pressure of the pump by varying the turbine speed. The centrifugal requires much less floor space, has no valve trouble, and can handle capacities far beyond any reasonable size reciprocating pump.

The pressure pump is usually a duplex reciprocating pump and because of its importance a very substantial heavy duty pump is desirable. Our experience indicates the use of an outside packed plunger type pump fitted with pot valves and suitable for 250 pounds discharge pressure.

Inasmuch as it is perfectly feasible to design a centrifugal filling pump so that at the end of the filling period the discharge pressure may be raised to that required for injection, we expect to see this development in the near future, and it will of course result in the elimination of a separate pressure pump and permit of utilizing the advantage of the centrifugal above mentioned.

In general, because creosote oil has a slight but definite chemical action on brass or bronze, it is considered desirable by most operators to make all pumps handling creosote of all-iron construction, iron not being appreciably attacked.

The air compressor in a treating plant is a hard-worked machine, as it is used in a number of different parts of the cycle. Probably its most severe duty, however, is that of pumping up the preliminary air pressure on the Rueping process. This service involves filling a very large volume with air up to a pressure of about 80 pounds in the least possible time, and for this reason it is desirable to use as large an air compressor as is consistent with the cost of same. A compressor which will attain 80 pounds discharge on the Rueping process in about 30 minutes, while it means a rather large machine, is to our no-

tion a good investment, as the whole cycle of treatment has to wait on this one feature.

It is possible, by using a large air storage receiver, to store a supply of air during times when the compressor would otherwise be idle, and the use of such a receiver makes it possible to reach the desired air pressure in much less operating time, or conversely, makes it possible to use a smaller air compressor. These large air receivers are expensive, however, and it sometimes figures out less expensive to use a larger compressor and eliminate the receiver, because, to be of any real service, the receiver has to be of very large volume.

Because of the high temperature reached during single stage compression to 80 pounds, and considering the fact that creosote vapor mixed with proper proportion of air may be explosive, we believe it desirable on single stage compressors to use an air cooler on the discharge, tho this is not often done. A still better arrangement would be to use a two-stage air end, which will give the other advantages of two-stage compression as well. In the interest of steam economy, it is usually advisable to compound the steam end, making the ideal compressor a two-stage compound machine.

The condensor system is a very important element in a treating plant. Vacuum specifications usually require maintaining a certain vacuum for a definite period, and do not consider the length of time required to reach this vacuum, so that any time saved in producing, say, 24" vacuum, is a net saving for the whole cycle. Furthermore, it is reasonable to suppose that from the physical phenomena of steam drying by this vacuum, that the quicker the vacuum is reached, the more thoro will be the drying, and also that on the Rueping process the quicker the final vacuum, the more thoro will be the kick-back of the oil from the wood. Some operators have claimed also that a quick vacuum after steaming on stubborn timber makes it easier to inject the creosote oil, due probably to opening the pores more thoroly.

We mentioned earlier in the paper the results possible with a modern vacuum system, and such a system embraces a special barometric condenser in conjunction with an air removal pump,

which may be either a steam ejector or a rotative dry vacuum pump, and also includes a water supply pump. The phenomena during the vacuum cycle in a treating plant are totally different from those in an ordinary steam power plant, and are treated in a paper prepared by the writer for the American Wood Preserving News, August, 1925.

The design of the pipework in a treating plant is a very important feature, because improper design will result not only small amount, particularly if welded headers and connections in large upkeep costs, but also in considerable waste of time during the treating cycle.

By selecting pipe materials of proper specification for their duties, and by carefully planning the pipe connections to take care of expansion strains, the upkeep may be reduced to a very small amount, particularly if welded headers and connections are used wherever practicable to reduce threaded joints.

There are a great many valves to be opened and closed during each treating cycle, and it is feasible to plan the pipework so that the controlling valves are all grouped within convenient distance of a central point, usually the operator's desk at the instrument board. Such an arrangement saves a lot of time due to the operator not having to run all over the plant or yard opening and closing valves.

From the operator's, as well as the inspector's standpoint, the instrument board and measuring tanks are very important elements of the operating system. Practically all specifications require certain definite conditions of steaming, vacuum, and temperature, both as to degree and duration, in addition to the actual requirements of quantity of preservative injected, and in order to have a permanent record of each treatment, it is almost universal practice to use recording steam, temperature, pressure and vacuum gages. It is also becoming customary to have a mercury column vacuum gage as a check on the recording gage. In spite of the importance of accurately measuring the oil injected, the devices generally used are rather crude and liable to errors, which are usually against the treating plant.

The writer devised recently a measuring tank system which, by the use of a very large and heavy guided float in the tank, the use of a piano wire connection running on ball bearing wheels of large diameter, and the use of a graduated metal scale with vernier attachment, makes possible very close readings of the oil level with very little chance of inaccuracy.

There is still room for improvement in the vacuum specification, because existing specifications apparently were written prior to the development of the modern vacuum system and take no account of the actual results of the vacuum. In other words, if a specification calls for a vacuum of 24" after steaming, to be maintained for one hour and thirty minutes, and we can tell definitely that after one hour of vacuum there is no more steam being condensed, the extra half hour is mere waste of plant time.

It is perfectly feasible with the vacuum system described to use a recording instrument on the gageboard which would show definitely when no more steam is being condensed, and this should be the point at which to stop the vacuum.

The question of steam use efficiency is of importance in every plant, and there is considerable room for improvement along these lines in creosote plants, with some problems unsolved. It is a simple matter to plan efficient boiler and furnace design, and it is unquestionably economical to insulate all live steam lines. The question of insulating the treating cylinder is apparently open to a lot of argument. We have a cylinder with perhaps 2500 sq. ft. area, which during various parts of the cycle is heated by live steam, and at first thought it would seem just as important to insulate the cylinder as the live steam pipes. Actual practice, however, shows that very few plants do cover their cylinders. This covering is an expensive item, and is subject to considerable wear and tear, while the problem of getting at a leak in the cylinder is rather an expensive one if the cylinder insulation has to be torn off to reach the leak. We believe, however, with modern cylinder design, where leaks have been reduced to a negligible problem, that quite likely the insulating of treating cylinders will become more and more prevalent.

Another feature of these plants which permits of solution, but which is not ordinarily taken care of, is the fact that the hardest demand on the boilers is during the steaming process, and during this process most of the steam-using machines around the plant are idle, so there is little heat for the boiler feed water.

A solution, tried out apparently with very good results, consists in using an exhaust steam feed water heater, and in conjunction with this, to install an ample storage tank in which a large reserve of boiler feed water is kept heated, partly by the feed water heater, partly by conducting all clean steam condensate to it, and partly by running all oily steam drains thru a submerged coil. This makes easier steaming for the boiler on peaks and it is certain to result in considerable fuel saving. One unsolved problem is the fact that while there are considerable quantities of waste steam available around a treating plant, and a quantity of heat is needed for heating the oil in the storage tanks, it is still necessary to use live steam for this purpose, because the temperature range between exhaust steam and tank temperature is insufficient to make practical heating by ordinary submerged coils. The answer probably lies in using an external heater with forced circulation to increase the velocity over the heating surface, and hence, the heat transfer rate.

In this connection, experience would indicate the desirability of using external heaters instead of submerged coils wherever heaters are used, because such heaters from a practical standpoint are much easier to examine for leaks and repairs, and from the design standpoint, make it much easier to predict accurately the performance, besides, being more efficient in use of heating surface, hence, lower in first cost.

In considering the design of a new plant, some thought should be given to the possibility in the early future, of treating imported timber; the plant just described is typical for the treatment of commercial native woods—the growing scarcity of timber will lead to the use of new native woods as well as of imported wood, and it is quite possible, may result in modified plant equipment.

Discussion

Mr. Todd: We were all very much interested in Mr. Nelson's paper, and it is now open for discussion by all members of both the Louisiana Engineering Society and the A. S. M. E., who are interested in the subject of creosoting plants.

I am sure Mr. Nelson will be glad to answer any question put to him.

Mr. Young, the question of vacuum specifications, which I think should be of some interest to you in specifying treatment for creosote timber at times, has been brought out by the speaker in connection with the vacuum system of treatment.

Mr. Young: Our specifications are full cell treatment. Of course vacuum is put on to extract moisture from the lumber and timber. It receives the oil. I don't know a great deal about creosoting plants, but I believe with a great many purposes Rueping process will give you good results for such lumber and timber as used by the Board of Port Commissioners. I believe in the full cell treatment. Of course in the Rueping process you time the vacuum so as to extract a certain portion of your oil and leave the amount in as specified. You also should know how to apply vacuum to extract moisture from your timber before the oil is extracted, but for our purpose, we like the full cell treatment.

Mr. Schneider: Can you give us some idea as to the steam requirements or boiler horse power required for plants of various capacities? I do not know how creosote plant capacity is rated, whether by amount of lumber that can be treated at a single charge, quantity of oil used, or some other unit.

Mr. Nelson: I don't understand your question. If you refer to the ratio of boiler capacity to cylinder volume, there does not seem to be any very different ratio. One rule that I have heard is for a two-cylinder plant to allow one boiler horsepower for each 35 c. f. cylinder volume. I have tried to check this up from a half dozen treating plants, of which I have boiler capacity records, but it did not agree very well, although the average was somewhere around that.

One plant with which I am familiar and which has two cylinders of about 5,000 c. f. volume each, is operating with one 229

h. p. boiler, which is unusually low, but due probably to the fact that the boiler is fired with a hand-stoker and can carry considerable overload.

MR. BRASELMAN: The operation of creosoting plants, I think, is a development of experience. We all started out in the business without knowing much about it, and it was necessary to experiment to know exactly what was needed. At our plant at Southport the boiler capacity has been added to from time to time until we now, with a cubic cylinder capacity of approximately 17,000 feet, have 600 boiler horse-power.

When we are putting the creosote into the timber the only steam used is that necessary for the operation of the oil pump, but when we are seasoning the timber we pour steam into the cylinder as fast as possible until we get the required pressure and heat. The essential feature in treating timber is to get it properly dried, and to do this it is necessary after the steaming period to draw in a very quick vacuum. If we try to exhaust the steam into a condenser it would take a much longer time and the timber would cool to such an extent that its boiling point would fall below that necessary to dry it under a vacuum. The steam from the cylinder is exhausted into the atmosphere through a large opening and the cylinder empties itself in about ten minutes. We then as rapidly as possible raise the vacuum until we get about 26", at which point water will boil at about 110° F. When we reach that point there is no more evaporation in the timber unless the vacuum is raised. Therefore speed of exhaustion of the steam is an essential factor.

There are lots of things that we do not know. I have been in the creosoting business ever since I was eased out of Tulane by our professor friends. When I came in tonight Mr. John Riess asked me what was the matter with a creosoted pile that rotted in ten years. I told him it was not properly creosoted and he said: "You did it." Now I do not know what happened to that pile, but the fault was either somewhere in the treatment or in its handling after being delivered at the job.

There are not many intricate things in creosoting, but some engineers would have us think so. We feel kind of responsible for Mr. Nelson, as he did most of his experimental work at the

plant of the Southern Creosoting Company at Slidell and at our plant at Southport. I am glad to see him sticking to the common sense idea of creosoting. It simply takes efficient machinery to do it. You have got to have good pumps and equipment to get the oil in and the moisture out.

For some reason, I do not know what it is, but the creosoting industry as a whole does not seem to enjoy the confidence of the engineer. When you fellows want to buy a generator or a motor you go to the Western Electric or the General Electric and tell them what you want. They write up the specifications. But when an engineer buys creosoted material he writes his own specifications even though he has never seen a creosoting plant or written a specification before. When he finds he needs creosoted timber, he gets out a lot of books and finds that the highest grade of lumber is shown to be 85% heart long leaf. He wants the best so he specifies it, and in addition wants it creosoted. Of course, he does not know that it is a physical impossibility for a creosoting plant to put creosote into heart lumber. It is impossible to secure a deep penetration of creosote oil into the heart, and if it were possible to have a charge of timber 100% heart, the penetration would not exceed one-quarter of an inch. The writer of this specification never takes into consideration the usage to which it is going to be put, and there is no reason for specifying 16 lb. of oil if 6 lb. will do. If piling are going to be used in water infested with toredoes, they should have 18 lb. of oil at least per cubic foot. On the other hand, if material wanted is cross ties which will wear out in twenty years, it is foolish to specify more than 6 lb. of oil. A consultation with the creosoting plant would save a great deal of money and annoyance.

Another thing to be considered is the amount of penetration expected from a certain treatment. 12 lb. of creosote oil is just so much creosote oil and goes just so far and no farther, and when your specifications call for deep penetration with small amount of oil, it is not the fault of the creosoting plant that it don't get it. Specifications should not be written so that the creosoting plant will not have some leeway in the matter. We have specifications calling for vacuum treatment of four hours. In two hours all of the moisture that it is practical to get out of

the timber is gotten out, and what happens after that—we just continue to pump without doing any good, but we charge just the same, and the engineer does not get any better job. The length of the vacuum period should be only sufficient that when there is no water coming out under a high vacuum we know that the timber is dry. This is something that I think all engineers should give a great deal of thought to.

The Dock Board are just as near having perfect specifications as we could get, and we use them whenever possible. To begin with, they use a character of timber grown on cut-over lands, as they specify dense pine. By doing that they get all of the structural strength necessary and at the same time we are able to furnish timber that has not much heart in it and we are able to creosote it so that it won't rot. Of course, big size timbers have a great amount of heart but the small sizes will have a great deal of sap.

It frequently happens that creosoted piling is delivered on the job, the contractor drives them down and cuts them off three feet, leaving an exposed section in the middle of the pile. This cut-off end should be coated with hot creosote oil mixed with slack lime, so that the top of the pile will be protected. I have seen creosoted piling in use ten and fifteen years which were nothing but hollow columns, the inside rotted and the outside practically heart. The same thing applies to lumber. The man on the job exposes the untreated part and we get the blame for the rot. I know this is the usual alibi for failure of treated material, but in all seriousness, this should be given a great deal of attention by engineers. The creosoting plants should be allowed some leeway from specifications and the engineer would get a better job. Where the engineer knows what he wants and has a thorough knowledge, we have no trouble. All creosoting plants today are interested in the material they treat. If it rots before it should they want to know, but it is not right to make creosoting plants treat timber contrary to the best practices and then hold them accountable for failure.

I would like, if possible, to have the Engineering Society and the A. S. M. E. to visit our plant at Southport, and if you gentlemen will set a date and all come out, we will be delighted to have you.

MR. SCHNEIDER: I was interested to learn that it is generally the case in creosote plants to use live steam for heating while a large quantity of exhaust steam is wasted to the atmosphere. I understand that this condition prevails because the exhaust steam is not sufficiently high in temperature to be utilized for heating. A number of years ago an engineer from Chicago told me of an absorption type ice plant there, in which he was using compressed exhaust steam. I have never investigated the thermodynamics of this matter, but if it should be practicable and economical, it would appear to be another way of utilizing the exhaust steam besides the application of external heat to such steam. I understood Mr. Nelson to state that the latter method has been used to some extent.

MR. NELSON: The only practicable means of doing as you suggest is to use a steam ejector as a compressor, and the trouble is that it takes about two pounds of live steam to compress one of exhaust steam, so that the system would not be economical. At the present time there is no practicable method of compressing steam economically for saving heat, although there are numerous applications waiting for such a device.

MR. GODAT: I want to find out when the Rueping Process should be used.

MR. NELSON: I am not a treating plant engineer, but I think I can answer your question. The Rueping Process is used principally for purposes where the wood would wear out mechanically before it would rot if treated by the full cell process, for example, cross-ties. There is no use in putting excessive creosote in the wood if such treatment would make the wood last longer than its normal mechanical life,—in other words, it's merely a question of saving creosote oil. I presume you understand the difference between the two processes.

PROF. GREGORY: I am sure that we have all profited by the paper on creosoting plants, as it has been most interesting and instructive. I want to remind some of the younger members of the Society of some tests made at Tulane University about fifteen years ago.

Mr. James Haugh built the long bridge or trestle across Lake Pontchartrain for the Queen and Crescent Railroad about 1884;

after some twenty-eight or thirty years, he took out seven of the stringers which were thirty feet long. They were six inches by sixteen inches in cross section. He sent them to Tulane University to be tested, because he wanted to know something about the material, whether it was as good as new material or if there had been some deterioration.

We cut these seven stringers in two, making each of them about fifteen feet long, supported them at a distance of twelve feet, and loaded them in the center and broke them. Two years later Mr. Haugh sent up five more and they were treated in exactly the same way. Then they looked up the record of the timber treating plant of the United States Department of Agriculture for treated timbers and for untreated timbers, of the same size, and we found that the average of results in these two cases showed that the timber was equal to new timber untreated, or to newly treated timber.

Now, of course, in testing timber you have a wide range of results, because you may have a great deal more heart material in one piece than you have in another. Certainly in a stringer thirty feet long, in the butt you have much more heart than you will have in the other end, consequently, the range of results shows quite a wide variation just as all wood tests, but having twenty-four separate tests, the conclusion which I stated was reached.

These tests were made about fifteen years ago at a time when the trestle was about thirty years old; it is now forty-three years of age, so it looks as if creosoted material is mighty good material for the engineers to use in this section, and I thought some of the younger men who are not familiar with these tests might be interested in this case.

One more thing; if the discussion is over, I want to express my appreciation and move a rising vote of thanks to Mr. Nelson for his excellent paper.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Minutes of the Board of Direction, April 11, 1927.

The meeting was called to order by President Lanphier, and the following members were present: Messrs. Moses, Fey, Todd and Muth.

The minutes of the previous meeting were read and approved, and bills on hand were ordered paid.

Letter was read from the Patent Office Library, London, England, and the Secretary was authorized to place this library on the mailing list, also to make reply.

Letter from Mr. Charles M. Kerr was read relative to an Item editorial, and the Secretary was instructed as to reply to make.

Mr. Roger E. Chesnut was transferred to Non-Resident Member.

On motion, duly seconded, it was voted that the Board recommend to the Society that our Society withdraw from the American Engineering Council, effective December 31st, and that part of the funds now paid into the Council for membership dues be used for an Engineering Scholarship at Tulane University, the details to be arranged by a committee on scholarship to be appointed by the President.

Mr. Ole K. Olsen presented to the Board a letter from Mr. Frank H. Waddill relative to form of appreciation to be accorded the charter members of the Society now residing in New Orleans. It was noted that several of the charter members of the Society have continuously been members of the Society and are still members. Colonel Sidney F. Lewis has already been made an Honorary Member.

The following motion was duly seconded and carried:

"That the Board recommend to the Society that the charter members of the Society who have been members continuously of the Society and who are now members, be elected as Honorary Members as follows: Messrs. A. L. Black, J. F. Coleman, Walter H. Hoffman, Gervais Lombard, Alfred F. Theard, also that the Society arrange a banquet in honor of Messrs. Sidney F. Lewis, A. L. Black, J. F. Coleman, Walter H. Hoffman, Gervais Lombard and Alfred F. Theard to show its appreciation of the services rendered the Society by these distinguished engineers. Furthermore, that the President be authorized to appoint a committee on ceremony of three members to arrange for a suitable ceremony at the banquet, which banquet shall be handled by the Entertainment and Outing Committee."

There being no further business the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Society, April 11, 1927.

The meeting was called to order about 8:15 P. M., Mr. E. S. Lanphier, President, in the chair, F. A. Muth, Secretary, and 58 members and guests present.

The minutes of the previous meeting were read and approved.

The following recommendation of the Board of Direction was read to the Society:

"That the Board recommend to the Society that our Society withdraw from the American Engineering Council, effective December 31st, and that part of the funds now paid into the Council for membership dues be used for an Engineering Scholarship at Tulane University, the details to be arranged by a committee on scholarship to be appointed by the President."

The matter was put to vote, there being 7 votes in the affirmative and 7 in the negative. The President stated that in view of the fact that it was a tie vote the motion was lost.

Letter of April 2nd from Mr. Frank H. Waddill to Mr. Ole K. Olsen which had been read to our Board was read before the Society. The letter brought out the fact that the charter members of our Society were men of high ideals who had done much to elevate the standard, personal and professional, and that the Society should take some action to publicly show its appreciation. The recommendation of the Board in the form of the following motion was then read to the Society:

"That the Board recommend to the Society that the charter members of the Society who have been members continuously and who are now members, be elected as Honorary Members as follows: Messrs. A. L. Black, J. F. Coleman, Walter H. Hoffman, Gervais Lombard, Alfred F. Theard, also that the Society arrange a banquet in honor of Messrs. Sidney F. Lewis, A. L. Black, J. F. Coleman, Walter H. Hoffman, Gervais Lombard and Alfred F. Theard, to show its appreciation of the services rendered the Society by these distinguished engineers. Furthermore, that the President be authorized to appoint a Committee on Ceremony of three members to arrange for a suitable ceremony at the banquet, which banquet shall be handled by the Entertainment and Outing Committee."

The above motion was duly seconded and unanimously carried.

This meeting being a joint meeting with the local chapter of the American Society of Mechanical Engineers, the meeting was then turned over to Mr. James M. Todd, Chairman. Some business was transacted for that Society, including the election of officers for the ensuing year.

The technical exercises of the evening consisted of an interesting address on "Creosoting Plant Design," by Mr. B. S. Nelson. This address was followed by an interesting discussion. A rising vote of thanks

was then tendered the speaker, and the meeting was then turned back to President Lanphier of the Louisiana Engineering Society.

The meeting then adjourned to the collation.

F. A. MUTH, Secretary.

Minutes of the Board of Direction, May 9, 1927.

The meeting was called to order by President Lanphier, and the following members were present: Messrs. Moses, Fey, Porter, Todd, Hamilton and Muth.

The minutes of the previous meeting were read and approved and bills on hand were ordered paid.

The names of F. Euseat and S. D. Jackson were dropped from the roll with regret.

The resignation of E. C. Brown was accepted with regret.

The Secretary presented to the Board the free mailing list for the Proceedings and on motion, duly seconded, it was voted that this list be continued.

The Committee on Entertainment and Outing attended the meeting of the Board and reported that its plans for the forthcoming banquet had been postponed owing to the present high river conditions. In view of the fact that it does not seem desirable to hold a banquet at this time, on motion, duly seconded, it was voted that the banquet to the new honorary members be indefinitely postponed and that suitable certificates of membership be furnished the new honorary members by the President.

Professor Donald Derickson, Chairman of the Committee on Civic and Industrial Affairs, presented his report, which covered traffic regulations, etc., for the City of New Orleans, which had been requested by the American Engineering Council. On account of the large amount of painstaking work accomplished by Prof. Derickson's committee, on motion, duly seconded, a vote of thanks was tendered Professor Derickson by the Board. The Secretary was instructed to transmit Professor Derickson's report to the American Engineering Council.

There being no further business the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Society, May 9, 1927.

The meeting was called to order at 8:10 P. M., Mr. E. S. Lanphier, President, in the chair, F. A. Muth, Secretary, and 82 members and guests present.

The minutes of the previous meeting were read and approved.

The Secretary made announcement as to the report of Professor Derickson, Chairman, Committee on Civic and Industrial Affairs, and

stated that the Board had tendered Prof. Deriekson's committee a vote of thanks for the fine work accomplished by this committee.

The President announced that owing to the high river conditions, on recommendation of the Entertainment and Outing Committee, the Board voted that the proposed banquet for the new honorary members be indefinitely postponed and that certificates of membership be furnished them.

The technical exercises of the evening consistde of an address on Pulp and Board from Steam Exploded Wood by Mr. W. H. Mason. This address was illustrated with lantern slides and was followed by an interesting and profitable discussion. A rising vote of thanks was then tendered the speakre.

The meeting then adjourned to the collation.

F. A. MUTH, Secretary.

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

JUNE, 1927

“PATRONIZE OUR ADVERTISERS”

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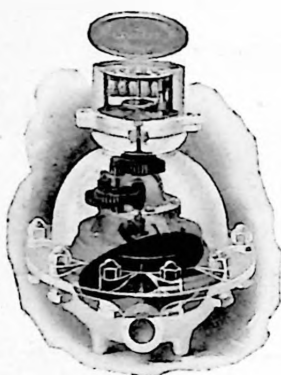
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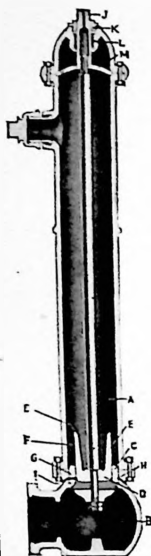
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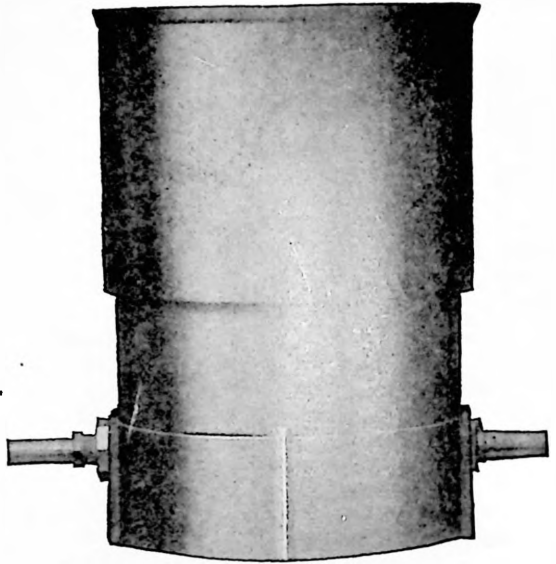
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EDITORIAL NOTES AND COMMENT

Masonite. This is the trade name for certain products, Presdwood and insulating board, made from sawmill waste by a process invented by Mr. W. H. Mason, who contributed a paper on the subject to the May meeting of the Society. The paper is highly interesting not only from the fact that it describes an entirely new process of making wood pulp, but also in the contrast that this method presents to the older and accepted methods of grinding the stock, so well known in connection with the manufacture of paper, and latterly adapted, with the necessary technical modifications, to the manufacture of Celotex from bagasse.

The control idea involved in the Mason process consists in the treatment of the refuse in the form of chips with saturated steam under high pressure followed by a quick increase of pressure to a very high point, 1000 lbs., and the sudden opening of the compression chamber so that the chips are forced

out as by an explosion and thus converted into pulp in the form of long fibres encrusted with the original wood lignins.

The Boards, whether insulating material or Presdwood, instead of being formed by passing the pulp through rolls, are formed by compression between steam heated platens in hydraulic presses. The Presdwood is finished $\frac{1}{8}$ inch thick and is very hard, dense and stiff, with tensile strength of from 4000 to 6000 lbs. per square inch. It has a density of approximately unity as compared with 0.7 for yellow pine.

The material comes out with a brownish color, and it is interesting to note that this color is produced in the process of manufacture and appears to be the same whether the wood itself is light or dark.

The paper was presented by Mr. Mason in an informal talk and was illustrated with lantern slides which cannot be reproduced here. The text as presented in this issue of the Proceedings is reprinted from Paper Trade Journal of February, 1927.

Stone Bases for Roads. Under this title Mr. Rodman Wiley, Vice-President and Sales Manager of the Kentucky Rock Asphalt Company, contributed a paper to the June meeting of the Society. By way of introduction he calls attention to the importance of the engineer in road building as well as in all other industrial projects, and the necessity for the engineer to hold an open and unbiased mind about all plans and new propositions.

Mr. Wiley states that there appears to be a more or less general consideration of the idea of using stone bases in highway construction and he cannot see why it should be so. The paper thus proceeds with the discussion of the proper methods of design and construction of the waterbound macadam base and the modified Telford base.

The concrete bases as well as the concrete surfaces for highway construction have come into such great prominence of recent years that one almost loses sight of the fact that practically all of our best highways, before the advent of the automobile, were built with stone foundations. These roads, how-

ever, rapidly deteriorated under the increasingly severe strain placed upon them by automobiles, although it must be noted that this deterioration was principally with the surfacing of the roadways. No doubt as pointed out by Mr. Wiley, many of the old foundations or bases are still in good condition and would make very excellent highways if resurfaced with some of the harder types of bituminous materials.

Perhaps one of the causes of popularity of concrete as a road material is the fact that the same material is used for both foundation and surfacing.

New Members. Since our last issue the following additions and changes of status have been made in the membership list of the Society:

Resident Members.

Lewis R. Ferguson, Manager, Portland Cement Co.

Arthur W. Hebert, Chief Engineer, The Flint Kote Co.

Leroy M. Law, Asphalt Technologist with New Orleans Refining Co.

Roger O. Wine, Field Engineer, Portland Cement Association.

Allan R. Wurtele, Engineer, Inland Waterways Corporation, Mississippi-Warrior Service.

Transfer from Student to Resident Member.

Edwin E. Elam, Assistant Engineer, Orleans Levee Board.

William W. Hay, Engineer with Mississippi-Warrior Service.

George P. Robbins, Jr., Robbins & Robbins, Engineering Sales and Contracting.

PAPERS AND DISCUSSIONS

MASONITE.

By W. H. MASON.

Read before the Society, May 9, 1927.

Masonite is a trade name adopted for products made from sawmill wood waste by a process which, through the use of saturated steam at high temperature and pressure, explodes the wood chips and produces a resultant wood pulp consisting of long fibres encrusted with the original wood lignins.

This has permitted the development of an entirely new commercial product, Presdwood, an extremely hard and durable board of great tensile strength, in which, by means of compression at a predetermined temperature, the wood lignins are made to serve as a binder to reweld the fibers in a compact mass.

A second commercial process that has been developed from this exploded pulp is the manufacture of an insulating board, which follows the usual process of manufacture up to the drying stage. Here it is handled in a hydraulic press, instead of through drying rollers, and by different variation in temperature and pressure from that used for the "presdwood," is given a hard compact surface on either side, with the insulating qualities preserved in the central mass.

By the use of the steam exploding process, the high power cost, and the laceration of fibers entailed in the mechanical grinding process, and the loss of 40 to 50 per cent of the material, which results from the chemical pulp process are avoided. The proper combination of degree and duration in temperature results in virtually complete separation of the wood fibers without noticeable deterioration in either the cellulose or lignin.

It will be interesting to paper manufacturers and engineers to know that the wood pulp first produced experimentally by the explosion process was immediately thought of as a possible source of raw material for papermaking. However, the first

experiments along this line did not give as good results as experiments in other directions, and as a result little has been done with the material along papermaking lines.

Since the Masonite process was announced, considerable interest has been manifested in the possibilities of the exploded pulp by the paper interests, and some experiments are now being conducted, but are not completed at this time.

It is natural that the paper manufacturers would display a keen interest in this process, since it uncovers a practically new source of raw material for them; the saw mill waste which hitherto for reasons familiar to paper men, has not been well adapted to the paper industry. Some of the questions that are doubtless in your minds can be answered best, I believe, by a detailed account of the experiments leading up to the commercial production of Masonite products, including a description of the mechanical equipment of the plant of the Mason Fibre Company at Laurel, Miss.

Preliminary Experiments.

As to the inception of the idea for Masonite, I was engaged several years ago in perfecting and operating a process for the extraction of rosin and turpentine from sawn boards, so as to recover valuable byproducts and at the same time raise the grade of the lumber. In my travels from one Southern mill to another, I was impressed with the great waste of raw material in the form of slabs, edgings, board ends and sawdust which were sent into the great trash burners for disposal.

The idea of finding some means of converting this waste wood into wood pulp took form. The mechanical grinding process was considered, but was discarded for the reason that power costs are high in this operation, and the gums of Southern pine woods quickly impair the efficiency of the grinding surfaces.

The chemical process was also rejected because of the loss of 40 to 50 per cent of the raw material in the digesters, the high cost of a commercial plant, and the difficulty of handling the bark on the slabs and edgings, a difficulty, of course, with which all paper men are familiar.

The idea was always kept in mind that in working with a raw material of practically no present value, some process of a comparatively inexpensive nature must be evolved in order to ensure commercial success.

The problem then resolved itself into the practicability of separating the fiber without losing the lignins. It occurred to me that wood being plastic when subjected to heat and moisture, and this plasticity probably being due to some change in the lignins under those conditions, it might be possible to soften the lignins and blow the fibers apart with the same steam that had been used to soften the wood.

Four Phases of the Problem.

There were four phases of this problem to be considered.

1. Application of temperature and moisture in such manner as to soften the lignins more than the cellulose fiber.
2. Means of releasing the steam practically instantly.
3. Application of the temperature in such manner as not to char or deteriorate the fibers.
4. The degree of pressure that would be necessary to disrupt the fibers at the time the pressure was removed.

The question of a working pressure came first. I knew it could not be done with 150 to 200 pounds, but just how much pressure was required I hadn't the faintest idea.

At that time—in the spring of 1924—I had a turpentine extraction operation at the plant of the Wausau Southern Lumber Company at Laurel, Miss. My experimental plant was in an old shed adjoining the sawmill plant, and my first steam gun was a piece of old shafting some three inches in diameter and about fifteen inches long.

In one end of the shafting we bored a hole, which was enlarged inside in cylindrical form to a dimension about twice as large as the size of the neck through which the boring was made. In one side of the shafting another small opening was drilled and a brass cup fitted on the inside of the cylinder and filled with oil, so as to make thermometer readings possible.

The outside of the gun muzzle was tapered to a ground valve joint and the valve was held in place by a round-necked

pin, supported in turn by a yoke surrounding the gun and bolted to the breech.

The gun chamber was filled with chips and water, the valve placed in the breech opening, and the pin drawn back against the valve by tightening the bolts in the rear of the gun, holding the yoke firmly against the pin.

Two gasoline torches were then directed against the side of the gun until the temperature on the inside rose to 480 degrees Fahrenheit, indicating a pressure of approximately 600 pounds. A four-foot long bar was placed with one end against the pin and a sharp blow with a hammer on the other end of the bar knocked the pin loose and allowed the valve to blow out.

The First Experiment a Success.

The first experiment with this makeshift gun was a complete success, so far as the defibering of the chips was concerned, although it took a long time to find the valve. The principle of steam explosion had been demonstrated at the first trial. For the rest it was a matter of continual experiment to establish the best working pressure and proper degree of temperature and time.

For some weeks this experimental gun was used, during which time different kinds of wood were discharged from the muzzle, at varying pressures. We even tried to make white wood fiber, but there was always some darkening caused by the steam. Subsequently, two other experimental guns were constructed, in which pressures as high as 900 pounds were utilized. It was determined that the time element was just as important in exploding the chips as the steam pressure and temperature inside the gun.

In present practice we subject the chips to a low pressure of 200 pounds for from 10 to 15 seconds, and then to a pressure of 1,000 pounds for from 3 to 5 seconds, before blowing them from the gun. This softens the lignins without damaging the fiber. We can apply the higher pressure direct for 6 seconds and obtain complete separation of the fiber, but the resultant pulp is not as good.

Having worked out a method of defibering the sawmill wood waste, the next step was to find the best product to be

made from the raw material. I took some of the fiber to the plant of the Bogalusa Paper Company at Bogalusa, La., where it was beaten up and made into a small sheet of paper by hand. The result did not look very good, so that attempt was dropped and another use sought for the material.

I might say here that one reason why some other product was desired arises from the great amount of waste wood material available and the necessarily limited market for the present paper products when considered in relation to the large supplies of raw material.

Masonite Insulating Board.

In looking over the various types of wood products to which the new raw material might be adapted, insulating board seemed to offer a natural outlet, due to the fact that the bundles of fibers from the steam explosion process give the puffiness, the loose structural characteristics and the minute air cells required for this class of work.

A beater was made out of an old gear, using angle iron for a bed plate. The fiber was exploded from the experimental gun, worked over in this beater, formed into a board by hand, compressed to one-third density in an old letter press, and dried in an over.

While experimenting with the insulating board we also tried out a hydraulic jack, which was used by the Wausau Southern Lumber Company as a wheel press. With this we compressed the material using a pressure as high as 5,000 pounds per square inch, but while the resulting board was fairly hard it did not show any characteristics out of the ordinary, so the experiment was temporarily abandoned.

Still continuing the experiments with the insulating board, we sent a carload of fiber to the plant of the Marathon Paper Mills Company at Rothschild, Wis. Here we constructed a small home-made fourdrinier 18 inches by 15 feet long, and used their beaters to handle the material. The perfecting of the insulating board proceeded satisfactorily.

Meanwhile the idea of a hard board had not been abandoned. We found a steam heated press which was used for making water-marked dies, put some of the insulating board in

it for further compression, and shut off the steam. Then we went back to the fourdrinier to continue an experiment there, forgot about the board in the steam press and went off to dinner.

Hard Board—Presdwood.

When we came back we found the press was hot, owing to a leak in the valve. Opening up the press we were much surprised to find a hard dense board, stuck to the felts and very imperfect in form, but nevertheless possessing qualities that appeared to be unusual.

This opened up another big field for experiment, and delayed for some time the use of the exploded fiber on a commercial basis. Returning to Laurel, Miss., we built a screw press with steam-heated platens, both top and bottom, and after four months of work finally evolved the right combination of fineness of the pulp, pressure in the press, and temperature of the platens.

One of the hardest problems was to keep the board from sticking to the platens, but solving this was merely a matter of technic, which has been worked out satisfactorily. We also found that the secret of success in making uniform hard board was to follow up with the pressure as the material shrank in the press. While the compression capacity of the press was very high, it was discovered that 300 to 400 pounds per square inch gave a good working basis.

A final development in the handling of the insulating board followed, almost as a matter of course. It was dried in the press, instead of through the roller drier, and not only came out in good condition, but with a hard finish on the outside surfaces, while the mass in the center retained its porosity and insulating qualities.

Plant Operation.

With these preliminary experiments concluded, the time for testing them on a commercial scale had arrived. The data obtained was laid before a group of lumber and paper-mill men, and as a result the Mason Fibre Company was formed for the purpose of building a plant. The venture was amply financed

by men whose interest was in the possibility of the utilization of a waste product of their industry.

The plant was completed in June, 1926, and after two months of experiments and adjustments, operations began in September. Initial production was at the rate of about 2,000 square feet per hour of presdwood and Masonite structural insulation for the first month, the plant having a rated capacity of 100,000 square feet a day on the basis of a 24-hour day operation. Production has been gradually increased and for January will run close to a million and a half square feet.

Raw material comes from the saws of the Wausau Southern Lumber Company's mill, which adjoins the Mason Fibre Plant. About two-thirds of the material is now used under our boilers for fuel, but if and when the economy of other forms of power is determined, substantially all of this mill waste will be available for fiber.

The material goes into a hog where it is cut into chips, and afterwards screened to substantially the same size as used in an ordinary paper mill; the chips are fed into the guns—of which there are three, each having a capacity of 200 pounds green chips. The charging valve is closed and high pressure steam valve opened until the pressure in the gun is about 200 pounds. This is held about 15 seconds and the full steam pressure of 1,000 pounds is turned on—in 4 or 5 seconds the discharge valve is opened and the chips forced out, exploded into fiber as they pass the ports.

The velocity, estimated at 4,000 feet per second, carries the fiber to the cyclone separator and the steam escapes to the atmosphere. The fiber drops into a stock chest.

Steam for exploding the chips is generated in a 400 horsepower Babcock and Wilcox boiler. The tubes are 2 inches diameter and $\frac{3}{8}$ inch thick. The drum is made from a solid steel gun forging 4 feet in diameter and 4 inches thick. The heads are placed in the drum and then each end is drawn down bottle shape, until the opening is 18 inches, and it is impossible to remove the manheads while the boiler is under pressure.

Manufacture of the Board.

Water is added to the fiber in the stock chest so it can be drawn out to the Wiener refiners. This is a new machine designed by John A. Wiener, superintendent of the plant, and is somewhat similar to a jordan in principle, except the material enters at the large end and is discharged from the small end. There are five of these machines—some used in parallel and some in series so some of the stock receives more refining than the average.

The refined stock passes to the fourdrinier, which is 5 feet wide and 36 feet long, with three pairs of press rolls. Close to the breast roll is a suction box underneath the wire, and a top felt over the sheet. The sheet is formed between the felt and the wire and is about 2 inches thick. In passing through the press rolls, this is reduced to about $\frac{3}{4}$ inch thick. Then it is automatically cut into twelve-foot lengths and is fed by a tipple feed to the racks.

Each rack holds twenty sheets, or about 1,000 square feet. These racks are on wheels and are pushed to position at one end of a press.

Four presses are required to handle the product. Each press contains twenty-one steam heated platens. The wet sheets are drawn in between the platens on wire cloth, and the press closed. These presses are operated by three hydraulic rams 50 inches in diameter and each press is capable of exerting a pressure of 2,000 tons.

In making an insulation board, the time in the press is from 50 to 60 minutes. When making presdwood, the time is about 25 minutes.

When formed on the fourdrinier, the board may be made into either a $\frac{7}{16}$ -inch thick insulating board, or a $\frac{1}{8}$ -inch presdwood, depending on the process of handling in the presses.

Each charge of a press produces approximately 1,000 square feet of board and when the press is discharged back into the empty rack, the boards are finished except cooling and trimming.

Characteristics of the Presdwood.

It is not necessary to refer here to the uses of Masonite structural insulation. The "presdwood," however, possesses some very unusual qualities which have already won for it a wide variety of uses.

Its great denseness, stiffness and hardness may be cited. While subject in a limited degree to moisture, being a wood product, its resistance is such, that the small absorption that does take place does not affect its hardness appreciably. It has a tensile strength of from 4,000 to 5,000 pounds per square inch, equal to many woods with the grain. Since this product, however, has no grain, the fibers being indiscriminately mixed, its tensile strength is equal in all directions, whereas in ordinary wood the strength across the grain is only about one-tenth as much.

One of its biggest uses at present is as lining for automobile doors; for desk tops, card tables, radio cabinets, wallboard and paneling and other specialized lines. It comes from the hydraulic press with one side smooth and polished, and can take any finish that can be applied to ordinary wood.

There are other prospective uses for the raw material from which these products are made, and experiments are now being conducted to establish them on a commercial basis.

Discussion

Mr. ALCUS: Have you tried using hardwood?

Mr. MASON: Yes, that is one of the first things we did after exploding long leaf pine, to see what other woods might be used for this purpose. We tried magnolia, poplar and gum, and they all worked nicely. I tried some oak, and while it exploded, it did not make a good job. I had spruce, white pine, redwood, and several others, and the explosion is carried on in substantially the same way. In some cases it requires a little difference in time and temperature.

The whole secret of this operation is temperature and explosion pressure. I made this presdwood out of pine because we were working on pine. I can make just as good boards out of

gun, which is supposed to be hard wood, and from a number of other woods I have tried. I don't think there is any difference. The lignin substance is substantially the same.

What I think we really do in making this board is, in getting the proper pressure and temperature, we reweld the lignins together, and instead of having wood with the grain running in one direction, we have no grain; it is equally strong in all directions. Take any hardwood as thin as this presdwood and you can break it in two. Of course, with the grain the wood is a little stronger than presdwood, but across the grain, presdwood is from ten to fifteen times stronger. It will stand four to five thousand pounds per square inch in tensile strength, sometimes up to six thousand pounds. It varies, just as wood varies. No doubt the manufacture is not perfect, but it usually tests 4,000, 5,000 and sometimes 6,000 pounds.

A MEMBER: Is the percentage of moisture of the presdwood substantially less than that of ordinary wood?

MR. MASON: It is down less than half of one per cent when made. When exposed to the moist air it will go about six per cent, a little less than wood, generally about three to four per cent less than wood.

A MEMBER: Based on the weight of a ton of wood you may use, approximately what weight of presdwood would you obtain from that?

MR. MASON: There is a small amount of material in wood that is soluble in water. This may be readily observed by noticing the lightness of driftwood which is wet and dried many times. These solubles generally run six to eight per cent. We lose a little more than that amount, but some of the loss is due to breaking apart of particles.

A MEMBER: What becomes of the resin material? Does not the high temperature of steam or water otherwise distill it off?

MR. MASON: In the explosion process, our tests indicate that about eighty-five per cent of the volatile resin material, that is turpentine and pine oil, is distilled off, but the resin apparently remains in the wood.

A MEMBER: Have you made any effort to recover the resin after the period of explosion?

MR. MASON: We have not attempted to recover the resin so far, for all this wood is waste from the saw mill and the largest percentage of it is sap wood due to the fact that the waste wood is chiefly made up of slabs and endings and the per cent of resin material in the sap wood is considerably less than in the heart wood of long leaf pine.

A MEMBER: You make it a point to use sap wood?

MR. MASON: No, but it happens that sap wood is the largest percentage of the waste that we get from the saw mills.

A MEMBER: Have you made any tests on the specific inductive capacity?

MR. MASON: I had some tests made and find that it is a very difficult thing to prove anything definite on that. Apparently in di-electric strength our presdwood compares favorably with ordinary red fibre.

PROF. ROBERT: Will it absorb water?

MR. MASON: It will absorb a small amount of water, probably in twenty-four hours twelve per cent, and in four or five days might take up twenty-four or twenty-five per cent, somewhere around there. That is as high as it will go. It becomes somewhat softer by absorption of water, just as wood does, but nothing like paper.

PROF. ROBERT: Would it be dangerous to build a small boat out of presdwood?

MR. MASON: I don't think so. I would not hesitate to ride in one.

MR. ALCUS: When you tried light maple and magnolia, did it make any difference in color?

MR. MASON: Yes, a lighter color appears.

MR. LANPHIER: How does paint adhere to it?

MR. MASON: Perfectly well: no trouble with paint, but it is advisable to size the board with shellac or a varnish for first coat. I might say a lot of this material is going into the automobile business. We have not advertised this particularly, but automobile people find it excellent in connection with the new type of pressed steel doors. The old composite door was made of hard-wood frame with the pressed steel put on the outside of it and cardboard on the inside and then the upholstery put on the card-

board, but now they are starting to use this board with no wooden frames.

PROF. ROBERT: What commercial use have you for this now?

MR. MASON: Automobiles, but we are selling a great deal to lumber dealers and it seems to be going into many uses, wall board, interior decoration, instrument cases and many others.

A MEMBER: It is going into the automobile industry?

MR. MASON: Yes, quite a great deal of it.

PROF. ROBERT: What is the price as compared with wood?

MR. MASON: That is rather hard to say. Take the mills I as familiar with, they sell lumber anywhere from \$20.00, depending on the grade, up to \$90.00. Our boards sell in carloads \$41.00 for the structural insulation and \$46.00 for presdwood, delivered, wholesale.

PROF. ROBERT: The square foot price?

MR. MASON: Forty-one and forty-six dollars per thousand square feet. Of course, the retail price is necessarily more.

PROF. ROBERT: Eight of these to an inch?

MR. MASON: That is one thousand square feet, about an eighth of an inch thick.

PROF. ROBERT: Will the wood warp when drying from moisture?

MR. MASON: No, unless you put a strain on it. There seems to be no tendency to warp and we have had no trouble or complaints, and I don't think it has any tendency to warp. I suppose you could warp it by soaking it in water and drying one side of it rapidly.

A MEMBER: How does it react to wood turning? Can it be turned easily?

MR. MASON: You see I have not made it very thick; the thickest we have made is about $3/16$ to $1/4$ of an inch.

MR. LANPHER: Did you try, Mr. Mason, shaping it as veneer is shaped, making it into curves?

MR. MASON: Yes, in any shape you want. You can mold intricate designs if desirable when you originally make it. Rather difficult to do it, however, after the board is made.

A MEMBER: What is the weight per thousand feet?

MR. MASON: About 750 pounds.

A MEMBER: The original wood does not weight that?

MR. MASON: No, it is heavier, specific gravity about one. Take yellow pine, it has a specific gravity of about 0.7.

A MEMBER: In operating your gun, do you turn off your steam before opening the lower valve?

MR. MASON: No, we leave it on, but the operator has learned from the sound of the gun when the last part is going out. When it makes this slightly different sound, he shuts the valve, as the gun is emptied.

A MEMBER: Would you put a thousand pounds on it until it is empty?

MR. MASON: Yes.

STONE BASES FOR ROADS.

By RODMAN WILEY,

Vice-President and Sales Manager Kentucky Rock Asphalt Company.

Read before the Society June 13, 1927.

It is always a great pleasure to address an assembly of engineers. When we consider the influence of engineers as it affects men in every walk of life today, we realize more fully the importance of the two requisites—fairness and open-mindedness on their part. As a matter of fact, practically everything of use to man today, not made by Nature, is the work of an engineer—the railroads, water-works, highways, radio, telephone, telegraph, electric light—in fact, all useful things.

Very seldom is an investment of any large sum of money made without a favorable report from engineers of recognized ability. An engineer on all work is, in the final analysis, the sole arbiter in all matters pertaining to the work. He has more power than that delegated to any man or set of men elected to public office.

It is possible to have on the bench in a murder trial a judge who may be unfair to either side—prosecution or defense—but there are twelve jurors to hold him in check. There is also the right to appeal. It is possible to have on the bench of our highest courts, men prejudiced on many subjects and against many things, but their associates have a voice in the decisions.

However, when it comes to construction work of any kind, specifications rarely admit of arbitration in case of differences. It is left to the opinion of the engineer as to what shall constitute good materials, good workmanship, etc.

When you know and understand the power delegated to engineers, you appreciate the fact that the engineer, of all men in authority, must be broadminded, mentally honest and fair.

An engineer should be equipped with a good education, supplemented by years of experience. He should know every detail of the work he is supervising; otherwise someone will suffer—the contractor or the owner. It is just as unfair, just as dishonest for an engineer to fail to pay the contractor for work

that he has done as it is for him to over-pay him. I cannot see any line of demarcation as regards honesty.

My remarks so far have been with the idea of impressing upon you the importance of approaching every question with an open mind.

Let us not get into the habit of arbitrarily condemning some type of work without making a thorough analysis of the proposition in question.

I hear stone bases for our highways generally condemned and, in my opinion, there is no reason for it.

Stone roads have, since the beginning of time, served for the convenience of man. The type has changed from time to time, also the details of construction, but in the end they were built of stone.

As you are aware, traffic conditions have changed greatly in the last few years, yet today we are building macadam roads and stone bases the same way they were built fifteen years ago. As a general proposition, the type does not prove satisfactory and, in my opinion, it is not the fault of the stone base, but the fault of the engineers designing and building it.

Recently, some real thought has been given to the design of broken stone bases. This, with particular reference to lateral displacement and subgrade conditions. It is my opinion that the principal failures of macadam and other types of stone bases are due to the fact that the voids have not been properly filled. This results in internal wear, causing an uneven surface.

In all the discussion that follows I am taking it for granted that drainage and unusual subgrade conditions will receive proper attention.

I suggest that a broken stone base be laid in thin courses so that the voids can be filled. The first course should be laid not over four inches loose. The stone shaped to the proper cross-section of the road and lightly rolled. I do not believe the roller should pass over it more than twice before screenings ($\frac{3}{4}$ inch to dust) are applied and broomed in. All visible voids should be filled, then rolled once or twice. Again apply screenings, broom and roll. Repeat this operation until the voids remain filled after thorough rolling. By lightly rolling and

spreading the stone in such a thin layer, the screenings, under the action of a roller, will shake down through the course of stone and thoroughly fill all voids; but if a thicker layer is spread, or if the stone is keyed too much before screenings are applied, the result will be that the course of stone is only choked for a depth of one or two inches below the surface, leaving the stone in the lower part of the course free to move.

This course should be lightly watered, but in no event with enough water to saturate the subgrade.

It is important that the stone and screenings be dry, otherwise it will be impossible for the screenings to sift down and fill the voids.

The second and third courses should be built as outlined for the first, except that the last course should be waterbound. The road should then be closed to traffic three or four days to allow it to dry. Excess screenings should be broomed off and the top laid.

It has been my experience that if the stone is spread in thin courses and care used in rolling, it is an easy matter to completely fill the voids and this will result in a rigid base, one that will remain smooth for all time.

This method of construction is no more expensive to the contractor than the method now used, except more screenings are required.

The average portable crusher will not, as a general proposition, make sufficient screenings, but this can be met by putting in a machine that will make screenings or by shipping in the desired quantity.

The thickness of such a base to carry modern day traffic must be left to the judgment of the experienced engineer.

A great many of us who have actually built roads in the capacity of contractors believe that greater stability is obtained when the first two courses are laid in one season and traffic allowed to pass over the base during the winter. The weak places that develop can be corrected in the spring and the top course laid.

Modified Telford Base.

The Modified Telford base came into some favor a few years ago. This was perhaps because of the wonderful service received from Telford bases built throughout the country, especially in Kentucky, between the years of 1810 and 1838. There are today in existence in Kentucky many sections of Telford base laid eighty to one hundred years ago. Such sections have been unprotected by a proper wearing course of stone or by any water-proofing material, yet they have withstood the action of traffic—have supported the loads. It is true, the work was done with a great deal of care and this was possible because of the cheapness of labor in those days. It does prove that design and details of construction really count and result in a worth while structure.

We know that some men will use the same amount of stone as that used by others under identical conditions, yet some roads are better than others. This shows the importance of details of construction.

There has been some dissatisfaction with the Modified Telford base in the last few years because of the fact that the surface would in a few years become uneven. Again I must say that I do not believe it is the fault of the type, but rather that it is due to faulty design and construction. The stone should, of course, be set shingle fashion, the idea being to break joint. The greatest dimension side of the stone should be set on the ground. The course should be about eight inches in thickness and especial care should be taken to get the stone as near to ideal shape as possible. But the principal idea is to have each stone eight inches in depth after knocking off the tops. Do not have some stone eight inches deep, some five inches, etc., and then attempt to bring to proper thickness with spalls in an effort to use all stone shot down in the quarry. The fine pieces which are easily knocked off with a hammer will serve to chink and level up the course.

After knocking off the tops, the voids should be thoroughly filled with some very fine material. The idea in using a fine material is to be certain it will sift through for the full depth of the course and completely fill the voids. It is best construe-

tion to do most of the void filling before very much rolling. In order to insure even compression some fine stone should then be spread on top of the Telford to properly even up the rough surface. Then roll until the course is well compacted. Apply more screenings, lightly water and roll.

Next apply a levelling course about three inches compacted. Fill the voids with screenings and water-bind. I think that if a base of this type is properly constructed it is one of the best types to build.

If greater depth is needed, add another course of stone and water-bind.

There are many sections of the country where sandstone and other soft stone can be found in abundance, and I am sure that it can be used economically for a base under some kind of an asphalt top.

I have merely discussed the waterbound macadam and the modified Telford base. It is believed that these types cover the general field. All others will be modifications, made necessary to suit some local conditions. The main thing, regardless of type or size of the stone, is to fill all the voids.

We should study soil conditions and design each section of the road according to supporting power of the soil and loads that must be carried, just the same as we study these things when designing a bridge abutment or pier. It is rank foolishness to arbitrarily build the base the same thickness and type for the entire length of the road.

I am strongly of the opinion that good highway engineering should contemplate the use of local materials, and I believe that, if engineers will give more time and study to local conditions and local materials, it will result in the saving of millions of dollars in the building of roads.

It may be found that the local materials do not meet standard specifications, but the base can be built thicker, or a new type designed, the idea being to use the local materials, if economical, to build a base that will support modern day traffic. It must be remembered that stone of an inferior grade can be used for a base whereas it would be totally unsuited if subjected directly to wear.

Reconstruction.

There are now over our country a great many old roads surfaced with macadam and gravel where the alignment, drainage, etc., is good and about all that is needed is to strengthen the base and add a bituminous top.

It is little short of criminal not to conserve the present investment in the surfacing. Good engineering naturally implies conservation, not destruction.

I think the best construction is to dig a trench across the road the width of a shovel at many places and measure the depth of the present base. For the purpose of calculating the amount of new metal to use, consider the present base 50% of its real depth. In other words, if the base measures 6 inches, value it at three inches. The reason for this is the fact that the old metal is filled with dirt and other foreign materials and certainly should not be given a much greater value as compared to new stone and new gravel.

It has been my experience that the best way to proceed with such construction is to fill the holes, ruts, etc., in the present surface with stone or gravel, lightly scarify the surface and properly shape it with a grader.

There may be some question as to scarifying, but it is believed best to do this, especially if less than 4 inches compacted new material is to be added.

By filling the holes before scarifying, the weak places will be properly strengthened. If the holes are not filled before scarifying, it is my experience that the depressions will follow the base to the surface because very fine material will be dragged into the low places when the road is shaped with a grader and there is no stability to the fine material dragged into the holes.

After the surface is properly shaped, new material can be added for a sufficient depth to make a stable base.

Engineers are slow to adopt new suggestions, but it is my experience that they are the fastest class of professional men in the world to follow, when once something is started that has the stamp of approval of a few reputable engineers. In this process of following, specifications are copied, ideas are incor-

porated into the methods of construction and we do such things without proper thought. It is simply because it is successful in a wealthy state like Wisconsin, New York, etc., and we conclude that such states will not make many grave mistakes. This sort of engineering is most dangerous. It will in the end standardize types and methods of construction which perhaps are not economical, or are totally unsuited to the section of country in question.

We must stop copying and do some real studying. Analyze every proposition from an engineering standpoint.

Conditions vary greatly in our country and the real engineer is the one who digests every problem. He should not build anything without a good reason for doing it. He should make a complete report on every proposition and give engineering and business reasons for every important step.

The first cost of a road is, of course, most important, but of far greater moment is the cost over a period of years—maintenance.

The building of roads is here to stay. People are demanding more and better roads and they are providing the funds with which to build them. Highway engineering demands today the best brains in the land, because hundreds of millions of dollars are each year invested in roads. Is the money economically expended?

What will the future disclose as regards the billions now being invested in roads?

I think that the work of building roads will become greater every year. As it stands today, and as it will always stand, no engineer should be so bold as to think he has solved the question as to the materials that should be used or types to build, because that varies according to available materials, soil conditions, traffic, funds, etc.

Let us, as engineers, be as certain as possible, in the light of present day knowledge, that we are economically expending the road funds. This will require much investigation, but it will protect the engineering profession in the years to come. It will prevent any stigma being attached to our reputations,

because of lack of study of each piece of work, because of mental dishonesty or because of moral weakness.

We must separate propaganda from facts. Millions of dollars are each year expended in advertising and in the publication and dissemination of literature in an effort to influence the building of certain types of roads.

Technically trained, high salaried men are daily writing and lecturing in the interest of certain materials.

The principles of real engineering will separate the wheat from the chaff and we can thank our stars that against all of this we have as a balance-wheel the same judgment of the real engineer.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY.

Minutes of the Board of Direction, June 13, 1927.

The meeting was called to order with President Lanphier in the chair, and the following members present: Messrs. Hamilton, Todd, Fey, Porter, Moses and Muth.

The minutes of the previous meeting were read and approved and bills on hand were ordered paid.

Bids for refinishing the library room, which had been solicited by the committee of which Mr. John L. Porter is Chairman, were canvassed, and are tabulated as follows:

Geo. E. Egdford.....	\$196.00*	\$373.00†
J. C. Maurer.....	230.80*	441.00†
C. N. Hurley.....	365.15*	542.00†

*For refinishing including papering walls and ceiling.

†For refinishing including canvassing of walls and ceiling, then painting on canvas.

On motion duly seconded, it was voted to accept the low bid of Geo. E. Egdford in the sum of \$196.00 for refinishing the room, including papering.

The report of the Membership Committee, Division B, was received, and on motion, duly seconded, the following names were ordered to ballot:

Resident Members

Lewis R. Ferguson,
Arthur Wright Herbert,
Leroy M. Law,
Roger O. Wine,
Allan Ramsey Wurtele.

Transfer from Student to Resident Member.

Edwin Essex Elam,
William Wallace Hay,
George P. Robbins, Jr.

There being no further business, the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Society, June 13, 1927.

The meeting was called to order about 8:10 p. m., Mr. E. S. Lanphier, President, in the chair, F. A. Muth, Secretary, and 44 members and guests present.

The minutes of the previous meeting were read and approved.

The Secretary announced the action of the Board in accepting the low bid for refinishing the library room, which work is to be accomplished during the summer months.

On motion, duly seconded, it was voted that the Society recess during the months of July and August.

The technical exercises of the evening consisted of an address on "Rock Bases," by Mr. Rodman Wiley. This address was followed by interesting discussion. A rising vote of thanks was then tendered the speaker.

The meeting then adjourned to the usual collation.

F. A. MUTH, Secretary.

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

AUGUST, 1927

“PATRONIZE OUR ADVERTISERS”

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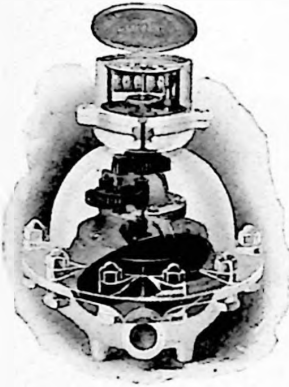
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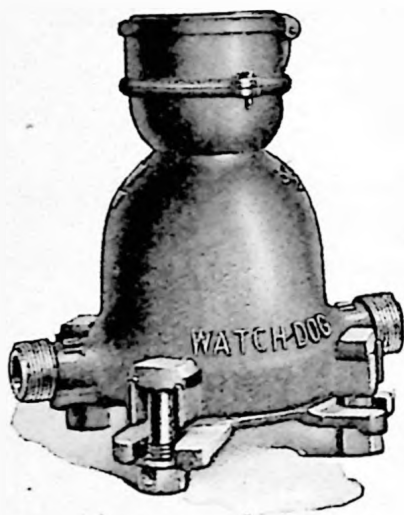
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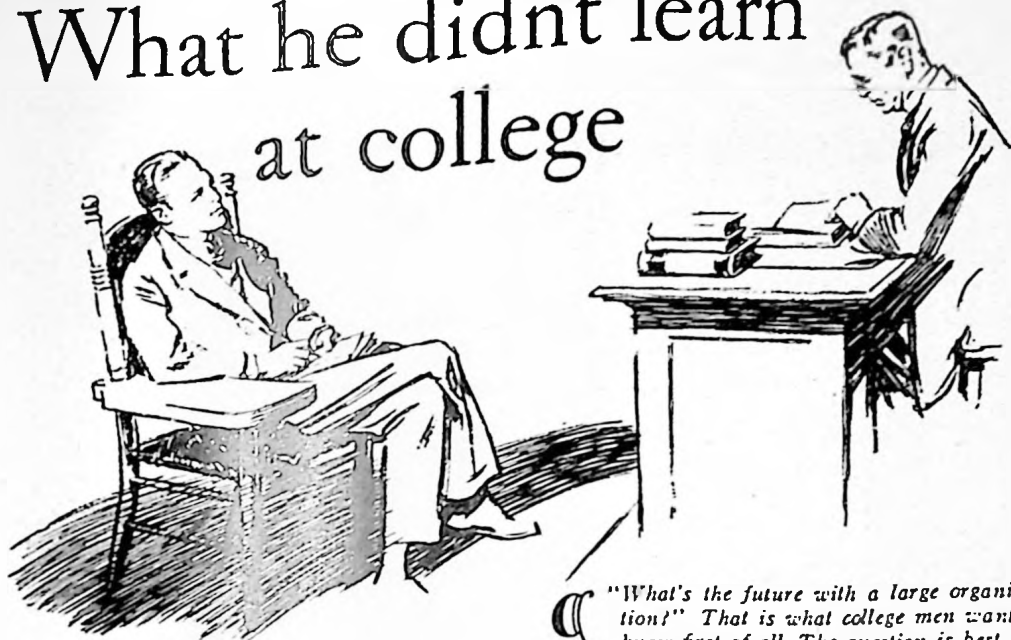
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What he didn't learn at college



LAWRENCE DAY
HOWELL

IN HIS class work, Lawrence Day Howell, Princeton, Litt. B. '13, E. E. '19, never heard of marine applications for electrical equipment. In fact, they were practically unknown. Yet, he now is in charge of the

Marine Section, Transportation Division, of the Westinghouse Sales Department located at New York.

When Howell came from college to the Westinghouse Graduate Students' Course, he had twelve months of thoroughgoing work in the shops at East Pittsburgh. Then he decided he wanted to enter the field which seemed most undeveloped and perhaps most promising of broad expansion. This was marine engineering.

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"What's the future with a large organization?" That is what college men want to know first of all. The question is best answered by the accomplishments of others with similar training and like opportunities. This is one of a series of advertisements portraying the progress at Westinghouse of college graduates, off the campus some five—eight—ten years. Write for booklet reprinting entire series.

1 1 1

In Howell's undergraduate days, this field was scarcely scratched — just as radio was not known to many young engineers when they were in college. A college man's opportunities are not bounded even by the amazing electrical developments now in existence.

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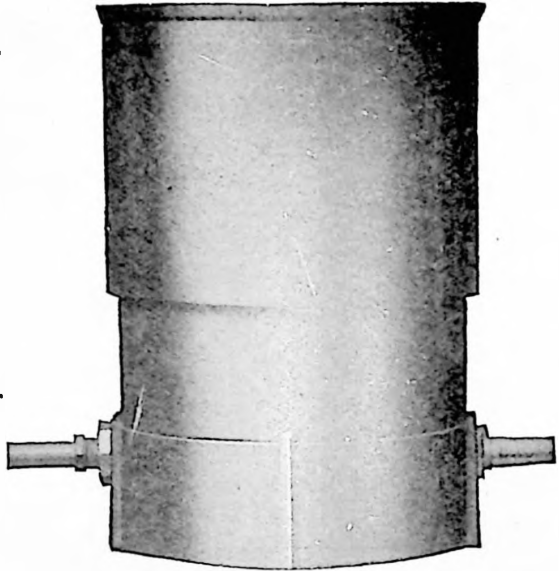
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The Proceedings of the Louisiana Engineering Society

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DOUGLAS ANDERSON, Editor.

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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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EDITORIAL NOTES AND COMMENT

Heating and Domestic Oil Burning. To the program of the September meeting of the Society, Mr. Chester W. Carr presented a paper, published elsewhere in this issue, upon the subject of Heating and Domestic Oil Burning. With a disavowal of any intention of assuming the role of punster, it might be remarked that this is a burning question. New Orleans is a city in which, from the character of its early history and development and for climatic reasons, also, central heating for residences has received very little attention until comparatively recent years.

This whole question of domestic heating has been, and is, closely connected with the problems of domestic service. When such service was abundant and cheap, it was not difficult to keep a number of open fires or stoves going in different por-

tions of the house, and these were quite effective as heating agencies except at times of unusually severe weather. From the aesthetic point of view, also, they gave an air of cheerfulness to the home, much appreciated by many people, particularly those of the older generation. From the engineering point of view, however, they were very inefficient, both on account of wasted heat energy as well as the great amount of labor involved in handling fuel and ashes.

The central heating plant improves the efficiency of the heating and concentrates the labor at one point in the residence, which latter is of great advantage in the handling of fuel and ashes. From the standpoint of the average householder, however, this is a somewhat doubtful advantage, as it has shifted the burden of care of the heating plant from the shoulders of the domestic service to his own.

While automatic stokers and labor saving devices for handling ashes and cinders have been of great service in large industrial plants, they are too complicated and too expensive for residence heating, in cases where coal is the fuel in question. Even here, however, automatic temperature control by means of devices for opening and closing dampers, has been of great assistance in lessening the burden of labor.

Oil is now the magic wand with which the engineer and the heating expert come forward to relieve the harassed householder of his worries and troubles. Even if other evidences were lacking as to the tremendous increase in the use of oil for domestic heating plants, one has only to pay a little attention to his olfactory senses on about any winter evening in almost any well-to-do residence district of this city.

Oil heating is ideal for the reasons that the fuel is fired automatically, the temperature is controlled automatically, and there are no cinders or ashes to be handled.

A considerable portion of Mr. Carr's paper deals with the problem of oil burning, from both the theoretical and practical point of view. He illustrates the way in which the theoretical principles have been used in the design of an efficient oil burner for domestic purposes by reference to the latest type of Noko! Silent Burner.

In the first part of the paper, Mr. Carr discusses the three types of heating system, warm air, steam and hot water. He does not think very much of the warm air system, principally on account of the difficulties of equalizing the circulation through the long and short ducts, and on account of the dust and other impurities which may come into the house with the circulating air.

Hot water, while a very good system in many ways, is not adapted to this locality on account of the slowness of its operation, both when heating up and when cooling off, with the quick changes of temperature to which we are subjected in a semi-tropical climate like this.

In Mr. Carr's estimation the ideal heating is to be secured by the use of the vapor system, using very low pressure steam. The details and advantages of this system are discussed at length in the paper.

Reorganization of the Division of Public Works. In his paper used at the October meeting, Mr. Schneider presents a plan of reorganization of the working forces of this department of the city government which is not at all revolutionary in character, but embodies certain features and suggestions which would certainly seem to work for greater effectiveness in the utilization of the laboring forces and for a greater degree of accomplishment in the varied routine tasks assigned to this department.

Briefly the plan proposed has as its basic idea the attainment of more adequate and more intelligent supervision of the laborers, and a greater flexibility or mobility of the laboring forces by means of which they might be shifted from one sort of work to another, dependent upon the demands arising from seasonal and other variations. On account of the very large number of bridges to be maintained Mr. Schneider suggests the formation of a special bridge section with a superior whose time is given entirely to this work.

The suggestions in this paper should commend themselves to the thoughtful consideration on the part of the city government.

Co-operation with the Colleges of Engineering. This caption is used to call attention to the resolution passed at the September meeting of the Society, which reads as follows:

“RESOLVED, That the Louisiana Engineering Society offer two Junior memberships in this Society, one to the Louisiana State University and one to Tulane University. The Junior Membership is to carry with it initiation fee and one year's dues. These prizes are to be awarded after the close of the ensuing school year to a Senior in Engineering who will graduate in June. Inasmuch as the prize is to promote interest and enthusiasm in the engineering profession, the Board requests that the award be based upon class standing, ability, character and personality, and that the award be made by a committee of each University composed of the Dean of the Engineering College, and the Professors of Civil Engineering and Mechanical Engineering.”

This is a very excellent move on the part of the Society and one that will be greatly appreciated by the two colleges to which the prizes have been offered. The members of the Engineering Faculty of Tulane University have always taken an active part in the affairs of the Society and have greatly appreciated the opportunities it has afforded them for their contacts with other engineers actively engaged in the practice of their profession.

The Senior students of both institutions are eligible to student membership and this is always taken advantage of by the whole Senior class in Tulane each year. The Tulane engineering professors look upon this opportunity which is afforded their students of becoming student members as a very valuable adjunct to the curriculum of the college and have always appreciated the privilege thus extended to these young men of meeting socially and hearing the discussions of engineers of experience and standing in the community.

It would appear to be a good suggestion to investigate the question as to whether some arrangement might not be worked out by the authorities of Louisiana State University to have their Senior Engineering class come down to the monthly meetings of the Society. In these days of effective transpor-

tation such a plan might be carried out without entailing any great loss of time on the part of the students.

This new action of the Louisiana Engineering Society is just another evidence of the spirit of mutual helpfulness and co-operation which exists to such a marked degree in this organization.

Rehabilitation of the Library and Reading Room. Attention is called to the very pleasing appearance of this room resulting from the work of the special committee appointed to take charge of it. Owing to leaks from the roof and the penetration of moisture through the ancient brick walls, both the ceiling and side walls had gotten into a lamentable condition. All signs of this damage has now been removed, and with the walls freshly painted in harmonious colors the room is very attractive, and no doubt this will add greatly to the comfort of those who use it.

A Donation to the Library. Mr. W. T. Hogg has recently donated the following books to the Library of the Society:

Train Rule Examinations Made Easy—By G. E. Collingwood.

Air Brake Catechism—By R. H. Blackall.

Modern Radial Valve Gears for Locomotives—By W. W. Wood.

Locomotives, Simple, Compound and Electric—By H. C. Reagan.

Electrical Machine Design—By Alexander Gray.

Locomotive Catechism—By Robert Grimshaw.

Electrical Engineering (Experimental), Vols. I and II—By V. Karapetoff.

Sewerage—By A. P. Folwell.

Statistics of Railways of the U. S.—By Interstate Commerce Commission.

Proceedings of the Society for the Promotion of Engineering Education, 1914, 1915 and 1916.

"A Unique Research in Civil Engineering." Under this sub-title *Research Narratives* publishes a very interesting account of experiments which have been made and are still in progress, to test the assumptions and theories concerning the effectiveness of the arch in the construction of dams.

This article is reproduced here:

Arch Dams

A Unique Research in Civil Engineering

Water serves humanity in many ways yet few persons know how engineers control it. Rain falls and snow melts irregularly; there are floods and droughts. In many places water must be stored, or its level raised, or its course changed, for development of hydro-electric power, for water supply of communities, for irrigation, for flood control, for navigation in rivers and canals. Dams are means to these ends. Some dams are walls of concrete or other masonry, of a variety of shapes. As engineers have been emboldened by experience, dams have been built higher. Many now exceed 200 feet and a height of even 700 feet has been considered. Because stored water becomes vitally necessary to those dependent upon it and because the breaking of a dam would in many places destroy life and property, dams must be unquestionably safe. Yet they may not be too costly.

A few centuries ago an engineer conceived that curving a dam upstream would make it stronger. A curved dam would in some situations act as an arch stood on its edge; hence engineers took advantage of the arch strength as revealed in bridges and buildings. A single curved wall will act as an arch only in a narrow canyon, or gorge, with steep rock sides. Also engineers used for dams across wider valleys series of arches, between buttresses.

Arch dams developed on assumption and theory. With safety in mind many curved dams were made so thick they could have but little arch action. About thirty-five years ago, an engineer built a dam in Bear Valley, near Redlands, California, so thin that conservative dam builders gasped. It still stands. Other thin arch dams were built in several countries. None built by an engineer has failed.

There was divergence of engineering opinion. Experimental knowledge was much desired, but obstacles were forbidden. In 1922, Engineering Foundation undertook an investigation. A committee of engineers was organized. Observations on existing dams were undertaken, but this method was difficult and slow. Available instruments were not satisfactory. Consideration was given to models and to methods and instruments. A meeting of the committee was enthused by a proposal from a large power company to build an experimental dam fifty to a hundred feet high, and the offer of a substantial contribution.

Financing and planning went along together. Power companies, industries, bankers, governmental bureaus, universities, American and foreign engineers joined Engineering Foundation in carrying on the investigation. Better instruments became available, some being devised especially by sub-committees and collaborators. For this full-size experiment favorable conditions existed not likely to be duplicated in many years. In the Sierras, 60 miles east of Fresno, California, Stevenson Creek tumbles down the mountain through a granite gorge into the canyon of San Joaquin River. On this creek was an ideal spot. It was near a tunnel through the mountain conveying a great volume of water to a power plant. A small pipe, controlled by valves, led from the tunnel to the creek, above the dam site, so that the reservoir could be filled as desired, like a tank in a laboratory. The reservoir was so small that the quantity of water needed was unimportant. Even if the dam should break while the reservoir was full, no damage would result. The power company was constructing extensive works in the region. Hence a works railroad, a highway, electric light and power, equipment, supplies, and skilled men were at hand.

When the excavation in the rock was almost ready for the dam, an untimely flood washed rocks and sand into the trench, causing delay and expense. June 4, 1926, the dam was completed to a height of 60 feet. It was shaped like a symmetrical, triangular piece of the side of a round can, stood on its point, curved upstream. It was built of portland cement concrete without steel reinforcement. Thousands of parts of instruments were embedded for making tests. Its

thickness was reduced from $7\frac{1}{2}$ feet at the bottom to only 2 feet 30 feet above and is 2 feet for the upper 30 feet. It is 140 feet long on top. Thousands of measurements of strain, deflection and temperature were made with the water at various depths up to 60 feet, and with no water in the reservoir, according to a program, from June to October. To have practically no change of temperature and moisture during a test, measurements were made at night. Late in November a flood overtopped the dam at least three feet, destroying the observation platforms and many instrument connections and partially filling the reservoir with sand and rock. This prevented cold weather tests planned for January. There was another flood in February. The dam still stands.

A celluloid model one-fortieth the dimensions of Stevenson Creek dam was tested with mercury instead of water. The results agreed remarkably. Models of larger sizes, of mortar and other substances, are being planned of dams of the same shape as the Stevenson Creek dam and several other shapes. Stevenson Creek dam should be built higher and tested until it breaks. Useful information has been gotten and is being made into a book.

PAPERS AND DISCUSSIONS

HEATING AND DOMESTIC OIL BURNING

By

CHESTER W. CARR

Read before the Society, September 12, 1927.

It is my purpose in this paper to present to you briefly the various types of heating systems, with my personal opinions as to the advantages and disadvantages of each.

Heating systems first may be classified as steam, hot water or warm air, according to the element used.

Steam systems may be divided into several major classes;—one pipe gravity, one pipe with mechanical return of condensation, vacuum, vapor, the last two being two pipe systems, one with mechanical suction on the return and mechanical return of condensation to boiler, the other with the system open to the atmosphere and gravity return of condensation.

Hot water will naturally comprise two classes, the open system, which is vented through an open expansion tank with the natural static head of the water in the system, and the pressure system, in which some mechanical device is installed to produce a pressure in excess of the static head, and to thus increase the circulating temperature of the water. A third classification might be made in which a centrifugal pump is used to accelerate circulation.

Warm air heating may be divided into natural and forced circulation systems, the latter with a fan placed in the fresh air inlet producing a positive force on the warm air runs, thus increasing the speed of circulation.

The warm air system commends itself chiefly on account of its low cost. Its other apparent advantages are its quick response to demands for heat and its somewhat doubtful role of a ventilating system.

The disadvantages of warm air are numerous. The large warm air ducts occupy valuable space when the heater is placed in a house with a full basement beneath the first living floor.

The circulation depends simply upon the natural rise of the warm air, and almost without exception certain rooms will be heated with difficulty or not at all. A high wind velocity against any one side of the house increases the resistance at the registers in these rooms and retards circulation of the warm air. This, of course, can be largely overcome by use of a fan in the fresh air inlet. The hot air system may bring fresh air into the house, but it also brings dirt, dust and germs, and if the air intake is in the basement, it will very likely bring coal gas, coal dust and ashes, the latter in the case of a coal-fired heater. The hot air system produces drafts and this will be especially noticeable in a forced system with a fan. Near the register there will be a rapidly moving blast of warm air. On the opposite side of the room there will be an equally rapid current of cold air.

The installation of a hot water system may sometimes be justified owing to structural conditions. In a small cottage, with no pit or basement, a hot water system would be indicated. In such a building (small or large) we are limited to one of three systems; hot water, one-pipe steam with a receiver and condensation pump, or a vacuum system with a vacuum and boiler feed pump. The cost of a vacuum pump on a small job, six or eight rooms, is such as to run the cost of a vacuum system out of reason. The one pipe steam, with a condensation pump would involve a cost not much, if any, higher than hot water, but the objection may be reasonably offered that the pump injects one more mechanical contrivance into the system, while the average householder wants a simple, trouble-free job.

As far as the boiler, piping and radiators are concerned, the hot water system costs considerably more than a steam system of the gravity type. The radiators are necessarily larger than steam radiators, owing to the lower temperature of the heating medium. Hot water is slow to respond to calls for heat. The entire system is filled with water, all of which must be heated and circulated before the rooms warm up.

Particularly in New Orleans, where our winter days are usually warm at mid-day, the hot water system demonstrates

its inefficiency. We will assume that the house is comfortably warm. Along about ten or eleven o'clock there is no longer any demand for heat. The dampers may be adjusted so as to lower the fire, or the oil burner may be turned off. But the radiators are still full of hot water, giving off heat which has cost money to produce, and which is not needed. The system cools down finally. The temperature suddenly drops. The fire is started again, but again we are faced with waiting for all the mass of water in the system to heat up and start moving before the house begins to heat.

The hot water system is slow to act, not responsive, and this feature is especially noticeable in this climate, where the demands for heat are sudden, and usually of short duration.

In any large residence the hot water system has no place. And in schools, churches, institutions, industrial plants or public buildings, the installation of a hot water heating system is a mistake from every standpoint. It is extremely costly to install. The radiation required is 60% in excess of that for a vapor or vacuum system, the mains run sometimes up into 8, 10 and 12 inch pipe, and the time required to heat an ordinary school building, (we will say) from a cold start in the morning will be probably four hours. Particularly in schools or other buildings where heat is required for only a part of the day, the hot water system is flagrantly out of place, inefficient and costly to operate.

Let us continue with the school job as our illustration. Assume the hours in which heat is required to be from 8 to 4. The janitor must be on the job at four in the morning to start the fire. Ten or eleven o'clock finds the outside temperature up around 70°. Windows are thrown open and the heat for which we are paying real money goes into the great outdoors. The fire must be kept up; the afternoon is still ahead; and heat may be required, or it may not be. But we can't afford to take a chance on cooling the water, with the possibility of more heat being needed. Four o'clock comes. The fires are banked or, in case an oil burner is used, it is turned off. The water in the system is still hot, and giving off valuable B.T.U.'s into a vacant building.

The ideal system is the vapor system with open return lines, the radiators equipped with modulated valves and thermostatic traps, large capacity vent valves on the ends of the main and the vapor return, and a return trap at the boiler to release the air from the returns and return the water of condensation to the boiler, regardless of boiler pressure.

This type of system insures a positive circulation in every part of the apparatus at a lower pressure and more quickly than is possible with the ordinary steam system. Each radiator may be heated partially or wholly as desired. It is economical in operation. There is no water hammer or pounding in piping or radiators. Radiator air valves are eliminated. Only one valve need be manipulated to control any one radiator. And finally it is fool-proof in operation.

The return side of the system is open to the atmosphere, so that the air is relieved at all times, and a positive pressure differential exists at all times between the supply and return sides of the system, so that the steam instantly enters the radiator whenever the valve is opened.

Operating thus on low pressures (ounces instead of pounds), it is economical. You are not using fuel to create sufficient pressure to force the heat into the radiators. The only pressure required is that necessary to overcome the frictional resistance in the pipes. Your fuel goes into **heat** and not **power**.

The thermostatic radiator trap, which opens for air and water and closes for steam, assures you that the radiator is always filled with live steam, always working up to its capacity.

As steam enters the cold radiator it forces the air out thru the trap and into the return piping. As the radiator is warmed the steam condenses. This condensation also flows out through the trap into the return piping. With the air all out of the radiator, the steam follows the water to the trap which, in the presence of steam, closes. The volatile liquid in the disc in the trap vaporizes at the temperature of steam which expands the disc, closing and holding the valve against its seat with a positive pressure, trapping the steam within the radiator. The

radiator now thoroughly filled with steam, continues to give off its heat, condensing the steam at a uniform rate, and the water of condensation flows to the trap, causing it to open and pass the water. The trap adjusts itself to a position corresponding to the temperature of the water and permits a continuous flow of water from the radiator.

It is evident that in such a system no air or water is left in the radiator, thus making possible a maximum heating efficiency of each radiator, and permitting any room to be brought to its desired temperature without high steam pressure. Further, by partly opening or closing the modulated inlet valve perfect control of the heat flow may be obtained.

The return trap is installed at the ends of the lines, various manufacturers making traps differing somewhat in design and detail, but all functioning in practically the same manner.

Condensation returns to the boiler by gravity, until the boiler pressure reaches such a point as to preclude this. The condensation collects in the return trap, lifting a float as the water line rises. The float, reaching a certain point, closes the vent valve on the trap, and next opening the steam valve, admits boiler pressure to the top of the trap. The pressure above and below the trap is thus equalized and the condensate returns to the boiler by gravity. With this device there is no danger of water being held in the returns due to high boiler pressure.

The vapor system as above described permits of smaller piping and smaller radiators than is required for a one pipe steam system, and of course much smaller than for a hot water system. The system is extremely sensitive to heat demands, highly responsive, quick acting and most economical.

The vapor system, with an automatic oil burner is the superlative in heating convenience, efficiency and economy.

My remarks on oil burners and oil fuel will be confined to their application to domestic installations, private homes and apartments, and to the automatic oil burner, controlled by a thermostat and intermittent in operation. I do not pretend to be an expert. My intimate contact with oil burners covers a period of eight years, and my remarks will be based on my

observations and experience, backed by a little theory, and supported in the main by generally accepted facts. I cannot go thoroughly into the subject in the time at my disposal. Even considering my limited knowledge, my chief difficulty has been to keep this paper within reasonable bounds.

Many misleading and false statements have been and are being circulated regarding fuels for domestic oil burners. One burner may advertise to burn "cheap fuel oil," and you may be told that the other burner requires distillate or gas oil or kerosene.

Now, to get right on this, you must know that all of these oils are in fact "Distillates." "Crude" oil is the product just as it comes from the well, and with the notable exception of Mexican Crude, this oil is not used in its original state as fuel. It contains products which have a higher value for other purposes, and which are taken out by distillation, the gasoline, being most highly volatile, coming off first, then naphtha and benzine, then kerosene, then furnace oil, gas oil, etc. They are all distillates. What is left in the retort is heavy, low grade fuel oil, with plenty of B.T.U.'s, but of low volatility. This oil is not adapted to automatic use, but is burned with great success by certain oil burners in industrial and commercial installations.

Whether the oil be 38-40 gravity or 28-32 gravity, it is nevertheless a "distillate." So the statement that *this* burner uses "fuel oil" while this *other* burner requires "distillate," is misleading, and whoever makes such a statement is misinforming you on this basic point.

All automatic oil burners require a distillate.

As you have seen, however, the range of distillates is broad. And the designation of an oil by its gravity alone does not tell us what we want to know as to its suitability for automatic use. Three or four samples of oil may be of exactly the same gravity, but will show marked variations in other important characteristics such as flash point, fire point, viscosity, sulphur content and sediment.

If the flash and fire points are low enough to ignite readily and positively as required by the intermittent operation of

automatic burners, if the viscosity is low enough to assure a steady flow in cold weather and not congeal at the elbows of the small piping of the automatic burner, if the sulphur content is low enough to insure the householder against unpleasant odors, if the sediment is close to zero so that the oil will not clog the small apertures, if these items are all satisfactory, then gravity in itself is of small importance. However, it is usually the case that the higher gravity oils will meet the requirements on the other points. Usually, but by no means always. So it is important to be informed on all these points before accepting an oil as satisfactory for automatic use.

Burning oil under conditions that obtain in industrial and commercial installations, and burning oil automatically under conditions that obtain in the average residence are two very different propositions, and the principles and practices of the industrial job cannot be applied to residence work.

In the one instance we have an engineer or janitor whose duties include attention to the oil burner, and who expects and understands how to clean the apparatus when necessary. In the other instance we have a burner installed somewhere down in the cellar or in a heater house, out of sight and, so long as it operates correctly, out of mind. The average householder doesn't know anything about it and, what is more, he doesn't want to.

For these reasons the domestic burner must have everything possible in its favor. The chances of clogging, or carbonizing or failing to ignite must be reduced to the minimum. And you can't have these conditions unless the fuel is clean, free-flowing and highly volatile. The fuel for the industrial plant is not the fuel for the home.

Mr. Frank A. Howard, President of the Standard Development Co., a subsidiary of the Standard Oil Company, in a recent address says:—"Furnace Oil" (this is 36-38 gravity) is the highest grade of distillate fuel oil which is generally distributed for use in oil burning equipment, not of the wick-fed type. It will give excellent results in practically all domestic oil burners. This product now commands in general the highest price of any fuel oil product, and is required for use in a

large percentage of burners, and justifies its somewhat higher price, through operating advantages it possesses in an additional large percentage of the burners now in use."

Mr. H. W. Camp of the Empire Refineries states: "From the description of the many household burners on the market, I believe that the majority of them have been designed to burn a relatively light fuel oil, or what might better be termed a heavy distillate, which would approximate a heavy kerosene. The convenience in the use of this lighter oil no doubt over-balances the lesser heating value, as compared to the heavier fuel oil. This cracked oil is particularly well adapted to household heating, since it has a low flash, and will ignite readily in the starting of burners, most of which are automatically controlled."

Having determined what is the proper oil for automatic burners, the next division of our subject has to do with the best method of burning this oil.

I am going very hastily into the matter of combustion, the general principles of combustion, and perhaps I should ask your indulgence for taking your time to present that which to a body of engineers is probably elementary. However, if you will permit it, I feel that it is essential as a preface to the subject.

Combustion is the rapid union of the combustible portion of fuel with oxygen, and in the presence of high temperature, it gives off intense heat. To efficiently burn liquid fuel it must be completely atomized, it must be mixed with sufficient, but not too much air, and a condition of constant high temperature must be maintained. By atomization I mean a dispersion of the oil in the air, so that each little globule of oil is surrounded by its own atmosphere. You cannot have proper air admixture with oil fuel unless you have atomization. If the oil spray is of a type which introduces large globules, it is a self-evident fact that the air admixture cannot be as perfect as it would be if the oil were minutely sub-divided. The more complete this atomization, the more efficient the burner, for the reason that the finer the sub-division of the fuel, the greater is the surface relative to the volume. And when true atomiza-

tion is realized, there is produced a mist which remains in suspension an appreciable time, each particle of microscopic size being surrounded by its atmosphere of air, and in condition for perfect combustion.

Assuming that we have a burner which mechanically produces this degree of atomization, our problem progresses to the point of combustion. In burning liquid fuel we get either complete combustion, producing $C O_2$, or incomplete combustion, producing $C O$. Perfect combustion produces 15.6% of $C O_2$ and the efficiency of a burner is determined by its approach to this point. A pound of carbon burned to $C O_2$ releases 14,500 B. T. U. approximately. A pound of carbon burned to $C O$ releases only 4450 B. T. U., indicating a loss of 10,000 B. T. U., this heat being wasted in the shape of soot and smoke.

The production of $C O_2$ is dependent upon the proper admission of air. If sufficient air is available, you will form $C O_2$, immediately releasing all the heat units the fuel is capable of yielding. But this combining of the $C O$ atom with another molecule of O , forming $C O_2$, can only take place in the presence of high temperature. If the temperature of the $C O$ atom, after its formation and before it meets the O molecule, falls below its ignition temperature, it cannot diffuse with the O molecule, to form $C O_2$, but passes off through the stack, carrying with it $\frac{2}{3}$ of the fuel, unburned. This results in high oil consumption, and gradually deposits a lining of soot on the boiler surfaces, further reducing the overall efficiency of the plant.

The problem, therefore, is to get the proper percentage of $C O_2$ in the burning of the oil.

Oil has been burned in factories and other industrial and commercial installations for many years. These boilers are fitted with refractory lining and chequer work and arches of firebrick for the purpose of getting the one essential element necessary to produce anything like complete combustion, and that element is temperature. However, the knowledge that has been gained in oil burning for industrial purposes, has done very much less than nothing to aid in teaching how to burn

oil in an automatic house-heating burner, as the conditions are exactly opposite.

You can't have the firebox walls of the boiler any hotter than the steam or the water within the boiler. The limit with hot water is 212° and the limit with steam at, say 3 or 4 lbs. pressure, is perhaps 220° . The temperature of the boiler sections or tubes is the temperature of the contents, steam or water. The open-flame burner, the shot-gun type, in which there is no part inside the furnace, may be a most excellent burner for industrial or commercial installations. In fact there are several really good ones available, some of which can show remarkably high efficiencies. But this burner cannot function properly in a house-heating boiler on account of the relatively cold walls. So we say we will build up with brickwork.

The heat absorbing surfaces and gas passages of these boilers are very meager as compared to the tubular or water tube boilers of the power plant. Now we are proposing to put in brickwork and deliberately shut off heating surface that is insufficient to begin with, further reducing the efficiency of the boiler.

The burner, to operate with any degree of efficiency, must work intermittently. The constant fire burner has never proved efficient for automatic operation. With the intermittent fire, when the heat does come on, it is seldom on long enough to produce the necessary temperature in the brick lined firebox, that is required for complete combustion. That is why I say that what we have learned in industrial oil burning is of no use to us in burning oil automatically in the home. High temperature is essential. It must be produced practically instantly. The C O atoms must be maintained at a temperature above the ignition point, or they will not diffuse with the necessary oxygen to form C O₂. Any device or construction that tends to cool the C O produces a low C O₂, and a loss of fuel.

I do not believe it is possible in an open furnace to get continuous, uniform and efficient combustion conditions, when operating that furnace on the intermittent principle, because

of the necessity of heating up the mass of brickwork each time the burner starts. And until this brickwork is so heated we are forcing twice as much fuel through the furnace as is actually converted into heat. The rest of it is partially burned and you are covering the boiler surfaces with the best insulator we know of, soot. This further reduces the efficiency of the plant, necessitating more fuel to do the work required. A layer of soot $1/16$ th of an inch thick reduces by 20% the ability of the boiler to absorb the heat you are producing. That is why I am convinced that the automatic burner which works with a confining means, which secures combustion independently of the boiler, is the burner that is efficient, and is the type that will endure.

If you will permit me to mention the name of the burner of this type with which I am most familiar, without the thought of selling you any particular burner, as I am trying to present my views from the angle of the engineer; and not the salesman, I can most clearly illustrate my argument with a product with which I am intimately familiar. Therefore, with your indulgence, I will tell you how in Nokol, with the confining means above referred to, you get the temperature element, and length of flame travel, independently of the boiler.

The confining means is the metal combustion chamber. However, this exists in principle only the fraction of a second after starting the burner, and as far as the entering fuel is concerned, the combustion chamber from that viewpoint ceases to exist. The effect that occurs immediately upon starting the burner is that the flame of the combustible is turned back upon itself until it completely envelopes the combustion area, so that from that moment on the fuel never sees the metal, but only the enveloping wall of flame. The result is that there is established practically instantly a condition of high temperature in and around the entering fuel, so that there is produced one of the prime essentials of combustion efficiency, temperature— independent of the boiler.

The other essential to which I have referred, is the time element, or length of flame travel. We don't want instantaneous combustion that is an explosion. The process must be gradual.

In the burning of solid fuels efficient combustion demands a distinct length or duration of flame travel, distance from the surface of the fuel bed to the nearest heating surface.

It is not practicable to get height in all cases, especially in house-heating boilers, and it is a distinctly difficult problem to secure this time element. If the fuel is not properly atomized it is going to shoot through and impinge upon the far side before it is even warmed up. If the combustion chamber could be extended several feet then all the oil might conceivably be in that chamber long enough to burn.

In Nokol you get length of flame travel, or this time element, regardless of the length or height of the firebox of the boiler. The flame is wound around in a spiral substantially horizontally, so that the same effect is obtained, within or close to, the combustion chamber without the necessity of enlarging the furnace.

I wish to emphasize the importance of these last two elements, temperature and time. In the first place, I have pointed out the difficulty, if not the actual impossibility, of creating conditions essential to the existence of these two elements in the ordinary house-heating boiler without resorting to the use of confining means such as a combustion chamber. With the presence of these two elements guaranteed the exact manner of introducing the oil and air into this combustion chamber, or the degree of atomization or the nature of the admixture, is not so important. A fair degree of combustion is still possible. It is my opinion that no device can meet the exacting requirements of a domestic oil burner without utilizing these essential elements I have enumerated, atomization, adequate and uniform admixture of combustion air and atomized oil, temperature, and time or length of flame travel.

The laws of combustion are identical, regardless of fuel. Combustion is merely the oxidation of combustible elements. Oil is practically 100% carbon and hydrogen. Carbon, oxidized completely, is carbon dioxide. Hydrogen completely oxidized is water. Coal is the same thing with a mixture of sulphur. So that the laws of combustion are identical whether it is a piece of coal or a drop of oil. First you must have your

two elements, oil and air, brought together before you can have a union. You must have them in the right proportion. You must have a combining temperature, and you must have time enough for that combination to take place. It doesn't matter whether it is oil, coal, wood or gas. In principle it is the same, and in the open furnace you don't have the necessary temperature, which is the weakness of that type of furnace. You start with an ice box and you end up with a furnace.

I don't believe it is possible to get anything like good combustion until the temperature has reached approximately 1000 degrees. And in the open furnace you lack uniformity of conditions. You have a different temperature every minute, and frequently before conditions of good combustion have been reached, the house has become heated, and the burner stops, so that in many cases, with short intervals of operation, conditions of good efficiency simply never are reached.

There are one of two things you have got to do to liquid fuel to make it burn. You must either vaporize it or atomize it. You convert it into a gas by the application of heat or you break it up into a fine mist; otherwise you cannot ignite it. If you were to drop a hot coal or a burning rag into a bucket of kerosene or distillate, or any other liquid fuel which is not-volatile at atmospheric temperature, the oil would quench that coal or rag. Non-volatile liquid fuel cannot burn in the liquid form. The hot coal does not produce a fire because the vaporization of the oil is not sufficiently rapid to support combustion. If that same mass of fuel was broken up into a mist then the burning coal would ignite it very rapidly, and it would stay ignited and would be consumed. Likewise, if that same fuel be heated and utilized in the vaporizing system, converting it from liquid into a gas by the application of heat, that hot coal or burning rag would readily ignite it.

However, there are many evils attending the vaporizing system. The great trouble is the carbonization of that portion of the burner subjected to the heat, and when the conversion from the liquid to the gaseous form takes place it throws off products of fuel in the form of carbon, so hard you cannot cut it with a diamond drill. That is not so good. This type works

well while it is new, but it soon fills with the carbon formation and is out of commission.

The other method then, is atomization. This is ordinarily accomplished by pressure on the oil line, forcing the oil through a minute opening at high pressure, sometimes as much as 80 to 100 lbs. This is dangerous. Nokol accomplishes complete atomization without the application of an ounce of pressure. Oil is not forced to the burner. In fact, it is lifted $3\frac{1}{2}$ " from a level below the burner, and a well developed atomization results.

I believe that you might be particularly interested in the latest development in Nokol, the New Silent Nokol. The harsh sound of combustion in oil burners, up until the advent of the Silent Nokol, has been caused simply by the rapidity of combustion. This sound is now a thing of the past. It has been completely subdued without doing violence to the fundamental laws of combustion or sacrificing any efficiency, and the temperature in the zone of combustion has been greatly reduced.

The distinguishing characteristic of the Nokol method of combustion lies in its ability to burn a flame arising from the ignition of raw oil and air and complete its combustion within 30 seconds by means entirely within itself, independent of refractory baffles, brick linings or boiler walls.

However, when all pure air and oil are introduced into the combustion chamber, as above described, this burning of a relatively large volume of liquid fuel in the unusually circumscribed area of a Nokol combustion chamber, with the air in excess necessary to prevent soot formation, is accompanied by the development of intense heat at the point of union of oil and air. The resultant immediate combustion and exceedingly high temperature produce a hard sound, similar to the ordinary blow torch. The building up of the uselessly high temperatures necessitates the use of high heat resisting alloys in the construction of the exposed parts of the burner. This noise has been practically eliminated.

It has long been known to those familiar with the laws of combustion that mixture of inert gas (incapable of itself of promoting or sustaining combustion) with the flame arising

from the union of the combustible in the fuel with oxygen from air, operates to greatly retard the liberation of the heat units of the fuel, and to effect a great dilation of the flame.

The first application of this rather mysterious phenomenon was made about 35 years ago in connection with the burning of lime rock, and later in burning brick. The idea was to sustain combustion at a point remote from the firebox. This was desired because, with coal as fuel, it was found that the intense heat resulted in the production of a lime that would not slake thoroughly, the rock being overburned in the vicinity of the furnace and improperly calcined in the center of the kiln. The same idea was later used in the manufacture of brick, and resulted in considerable litigation.

A most interesting statement is found in these records to the effect that this use of an inert gas, such as flue gas, could not be applied to the burning of fuel in a heating boiler, as this diluted flame would not burn in contact with a metal wall when such wall was cooled on the other side. And farther that the only way to successfully control the combustion of burning fuel with a mixture of pure air and inert gas was by the production of a slow burning flame, and then the perfection of this flame in a hot-walled region; that is to say, the combustion of a flame arising from a mixture of fuel gases, with pure air and the flue gases, could only be perfected by conducting such flame a distance from the point of generation into the spaces between the incandescently heated brick, as piled up in the kiln, and in direct contact with these hot refractory surfaces.

I have gone into this matter of the first and only successful attempt to utilize flue gases in the burning of fuel, to emphasize the fact that in Nokol has been accomplished that which was heretofore considered impossible.

The New Silent Nokol demonstrates the successful manner in which advantage has been taken of flame dilation, resulting in quiet combustion, and of retarded combustion resulting in greatly lowered temperatures in the combustion zone, all by the carefully controlled use of the flue gases.

To produce these results a portion of the $C O_2$ from the stack is drawn into the blower through a conduit from the smoke pipe and mixed with the pure air of combustion and atomization. It is desired that these gases be cooled as much as possible. Therefore the gases are taken from the smoke pipe, rather than the boiler itself. The length of conduit from the smoke pipe to the blower housing affords additional radiating surface for the dissipation of the flue gas temperature.

The visible effect of forcing a mixture of flue gases and air into the combustion gases, is a seemingly great increase in the volume of the flame, while it is in fact more of a dilation of the flame.

In the ordinary procedure of burning the fuel gases in the presence of all pure air in a Nokol combustion chamber there is a full development of heat at the point of union, instantly forming a localized zone of rapid and intense combustion, accompanied by dull undulations and high-pitched sounds. But, on introducing a neutral diluent, as afforded by the flue gases, combustion is retarded or postponed, the intense local combustion at the point of meeting of air and fuel gas is avoided, and the greater portion of the heat development is removed from within the combustion chamber to a point immediately above it. As the flue gases tend to weaken the oxygen and the combustible gases evolved from the fuel, rendering it more difficult for each to find the other and combine, combustion eventually takes place without commotion, agitation or noise.

Because of the fact that the diluent flue gases tend to postpone combustion, care must be exercised as to the quantity used and the time of introduction. The laws of combustion are even more exacting when dilution is resorted to than when all pure air is used. These items are taken care of in a clever but simple manner by the Nokol mechanism. In the practical application to the house heating boiler of the use of flue gases for the purpose of silencing combustion and avoiding the high temperature evolved from localized, intense, rapid combustion, the entire perfecting of combustion must be accomplished in the immediate vicinity of heat generation. In the case of the lime kiln and the brick kiln, incandescently heated refrac-

tory surfaces, and the radiant heat therefrom, was essential to the completion of combustion of the slowly formed and comparatively low temperature flame evolved from a mixture of flue gases. No such agency is present or possible in the house heating boiler; only cold surfaces present themselves to the slowly formed, low temperature flames, which, upon contact therewith would be immediately extinguished.

However, in connection with the Nokol method of combustion, wherein means are provided for the initiation and completion of combustion independent of brick linings or boiler temperature, or other boiler conditions, resort can be had to the free use of these diluent flue gases for reduction of noise and temperatures.

In practice it is only necessary to initiate and complete combustion by the use of all pure air in the regular manner, and after one to three minutes from the time of perfecting combustion and effecting high temperature in the combustion chamber, then, and only then, are the flue gases, in carefully measured proportion, permitted to enter the combustion chamber, to at once perform their mysterious duty of dilating the flame, to the destruction of sound and the reduction of temperature.

This is accomplished automatically by manipulation of a butterfly valve in a mixing chamber. This valve remains in such position as to admit all pure air to the fan (and then to the combustion chamber) for the first two minutes of the cycle of ignition. During the last minute of this three minute cycle, the butterfly valve is moved to a position admitting stack gases in such proportion as has been determined to be correct by test on each installation. The pure air inlet is shut off to the same degree that the flue gas port is opened.

From this procedure it is seen that flame dilation is not attempted until well after complete combustion and high temperature conditions have been established. Differing from the process followed in the brick and lime kilns, complete combustion from all pure air and fuel gases is first established, and then dilution is effected to just the point necessary for noise and temperature reduction. In the kiln process, it was sought

to produce dilation and temperature reduction as the first step, and then perfect or complete combustion by the addition of more air in the presence of radiant heat from refractory surfaces, as in the calcining of lime. In the brick kiln the gases first formed are sent directly against the highly heated refractory surfaces.

It is thus seen that the Nokol process is in direct opposition to that which has gone before, and is the first to successfully apply flame dilation to a heating or power boiler.

A REORGANIZATION PLAN FOR THE DIVISION OF PUBLIC WORKS OF NEW ORLEANS

By

CARL SCHNEIDER

Read before the Society, October 10, 1927

It is the unique distinction of the Division of Public Works that it comes into closer contact with the public than any other branch of the municipal government. Practically the entire inhabited portion of the city and every person in some manner or form feels the results of its service or lack of service. It has long been a bone of contention among political parties and the success of an administration is measured to a large degree by the performance of this division.

It is no small organization. The expenditures for the present fiscal year will be in the neighborhood of \$1,200,000. The replacement value of its equipment exceeds \$300,000, and the value of the buildings and land required for its activities approaches \$500,000. Between 700 and 800 men are employed in the Division of Public Works, the number presently engaged being about 790.

Most persons, it is presumed, are familiar, in a general way with the work performed by this branch of the municipal government. Its functions include:

- Cutting grass and weeds on sidewalks, streets and vacant lots;

- Ordering and inspecting the repair and paving of sidewalks;

- Ditching, grading and surface improvement of unpaved streets;

- Cleaning paved streets;

- Garbage and rubbish collection and disposal;

- Construction, maintenance and repair of bridges, culverts, crossings and footlaps;

- Servicing the many pieces of equipment used in its work.

Besides the foregoing work of regular order, numerous "odd" jobs are continually being shunted to the division; "bucks" that have been passed from other quarters, or "orphan" jobs that seem to fit nowhere else.

It has never been the case, and probably never will be, that the work has reached the ideal standards. The limitations of attainment toward such standards are quite naturally fixed by appropriation. It has therefore been found not only wise and expedient, but altogether necessary to maintain relatively higher standards in those classes of work that are most essential to public health and public safety. Hence we find that garbage collection, bridge maintenance and street cleaning outranked the other classes of work, although it is by no means conceded that any of the work whatever is deliberately neglected. Further, it is admitted that local conditions often determine the relative importance of the work from the public point of view. The person living on an unpaved street is more concerned with ditching and grading than with cleaning of paved streets. Discussions of such matters on complaints often develop interesting verbal combats with the taxpayers.

Practically all of the work is of the routine or maintenance order. As a consequence, the expenditure of the budget does not result in the building of any monuments to decorate the landscape of our fair city. We spend over \$400,000 a year for garbage and rubbish collection and disposal, and not one dime of this expenditure goes into fixed assets of the city. It is only on bridge construction and repair and, to a smaller extent, on improvement of unpaved streets, that the work of the division has any value for succeeding years.

It might be well at this point to give some idea of the magnitude of the work to be done. About 400 tons of garbage and rubbish, or 1200 cubic yards, are collected and disposed of daily. There are about 280 miles of paved streets or 3,200,000 sq. yds. About 1,200,000 sq. yds. are cleaned and about 800,000 sq. yds. are flushed every day. Between 250 and 300 cu. yds. of dirt and litter are removed from the paved streets daily. The bridges to be maintained include 14 movable spans over the New Basin Canal and Bayou St. John, about 120 fixed spans over drainage canals and, it is estimated, over 30,000 culverts, crossings, and footlaps required for unpaved streets. Nearly 1,000,000 board feet of lumber are used every year on such work.

The unpaved street problem will probably be here for some years to come. There are over 700 miles of such streets, some of which are in varying stages of improvement; a large portion, however, are practically in their natural state. The budgets allotted to the division have not been sufficient to provide for the purchase of such material as shells or gravel on a scale that would rapidly produce results in this work. Consequently for a number of years, the work of the division, on making such streets passable in rainy weather, has been limited to placing broken concrete, brickbats, etc., or "hard filling," as it is termed by the workmen. Although no outlay of funds has been necessary for this material, the economy of the practice is questionable when it is considered that such work often operates to the detriment of improving the streets with some low type of surface. The logical method to improve such streets is by contract and local assessment for the benefit. On a street properly surfaced the maintenance problem is greatly simplified.

In the matter of ditching, the problem has been greatly reduced by the installation of sub-surface drainage for nearby paved streets. Areas served by sub-surface drainage are seldom flooded by storm water as a result of inadequate ditches. Waste water from houses is troublesome only in unsewered areas, and, due to numerous driveways at varying elevations, it is practically impossible to carry off such water in open gutters to the drainage canals. In a large majority of the cases of complaint relating to gutters needing cleaning, the remedy simply calls for cutting grass and a slight amount of shovel work to improve appearance. It cannot be denied, however, that in most of this work intelligent supervision seems to be lacking, and the output has been rather small in proportion to the expenditure for this work.

The grass and weed problem assumes astounding proportions during the summer months, particularly in periods of excessive rainfall. During the past summer, for two months, the entire ditching forces were diverted to cutting grass, and despite the fact that over 350 miles of sidewalks, gutters and streets were cut, the subsequent growth was so rapid that the

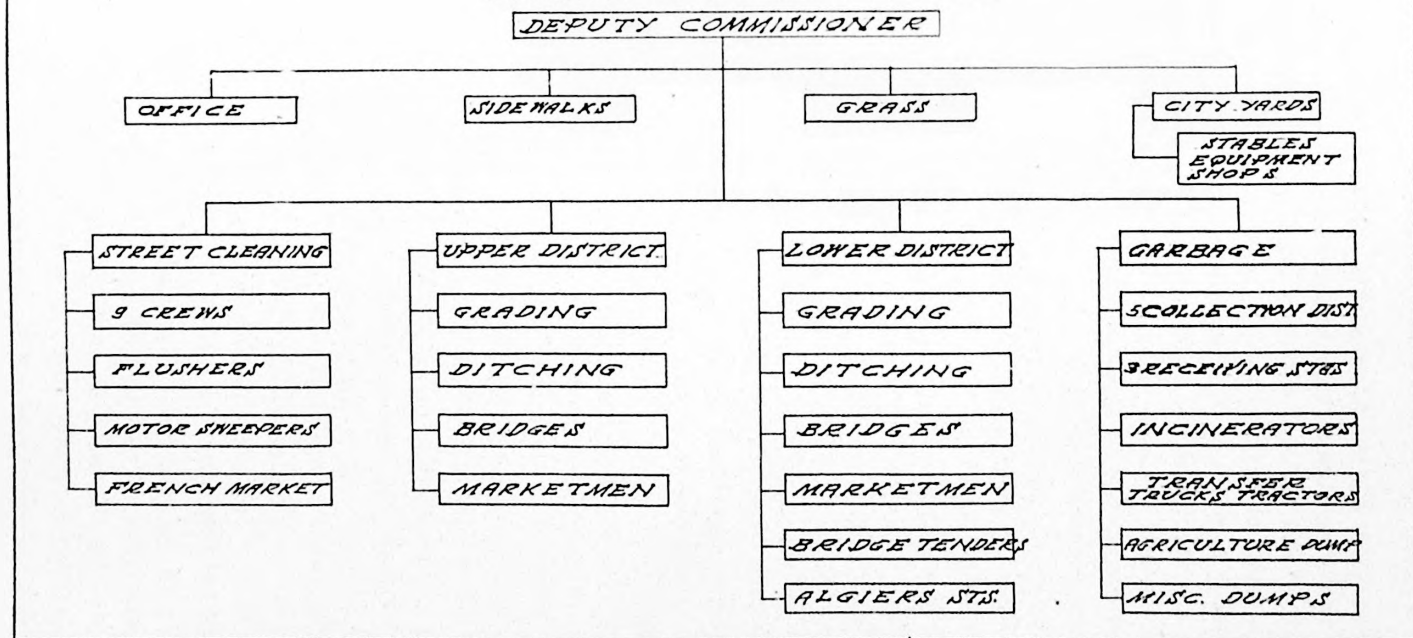
work done was hardly noticeable. In many instances the lack of co-operation from the public in this class of work is distinctly burdensome.

Owners or tenants may be required by ordinance to cut noxious growths of grass or weeds when over one foot high on sidewalks and when over two feet high on vacant lots. Upon their failure to do so within ten days after notice is served, the city may do the work and charge the cost to the owners. The charges assessed by the city for such work are usually less than actual cost, and much less than it would cost owners with hired help. As a consequence, nearly everyone waits on the city to do the cutting and the volume of the work is at times much greater than the forces can handle. This is truly seasonal work and temporary forces should be engaged to handle it. The cutting of the lots and sidewalks should be self-sustaining.

By legislative act, the Commissioner of Public Property is empowered to order the paving of sidewalks, one block or less in extent, when it is deemed necessary in the interest of the public. Upon failure of the property owner to pave within a certain period after receiving notice, the city may have the work done by contract or with its own forces and assess the costs against the property. As mail deliveries are contingent upon adequate sidewalks, the development of new residential areas has brought about a large demand for this work. Unfortunately, the formalities incidental to legal requirements and the securing of bids and awarding of contracts result in long delays that do not help the service. Engineering advice and service in this work as well as on canal bridge work is furnished by the office of the City Engineer. The Division's activity consists of serving notices, inspections, and keeping records of the transactions.

Present Organization. As at present constituted, the organization of the forces is along functional lines. Each class of work is under the general supervision of a superintendent and foremen, and workmen are constantly engaged in the same class of work. The distribution of the forces can perhaps most readily be understood by reference to an organization chart.

*PRESENT
ORGANIZATION CHART
DIVISION OF PUBLIC WORKS*



The chart for the most part is self-explanatory. Julia Street and the New Basin Canal divide the upper district from the lower. Each of these districts is under a superintendent who, as is seen, has charge of all matters pertaining to unpaved streets. In addition, the superintendent of the lower district also has charge of the bridges of the New Basin Canal, Bayou St. John and drainage canals. The five garbage collection districts each comprise three or four wards, an inspector being in charge of each district.

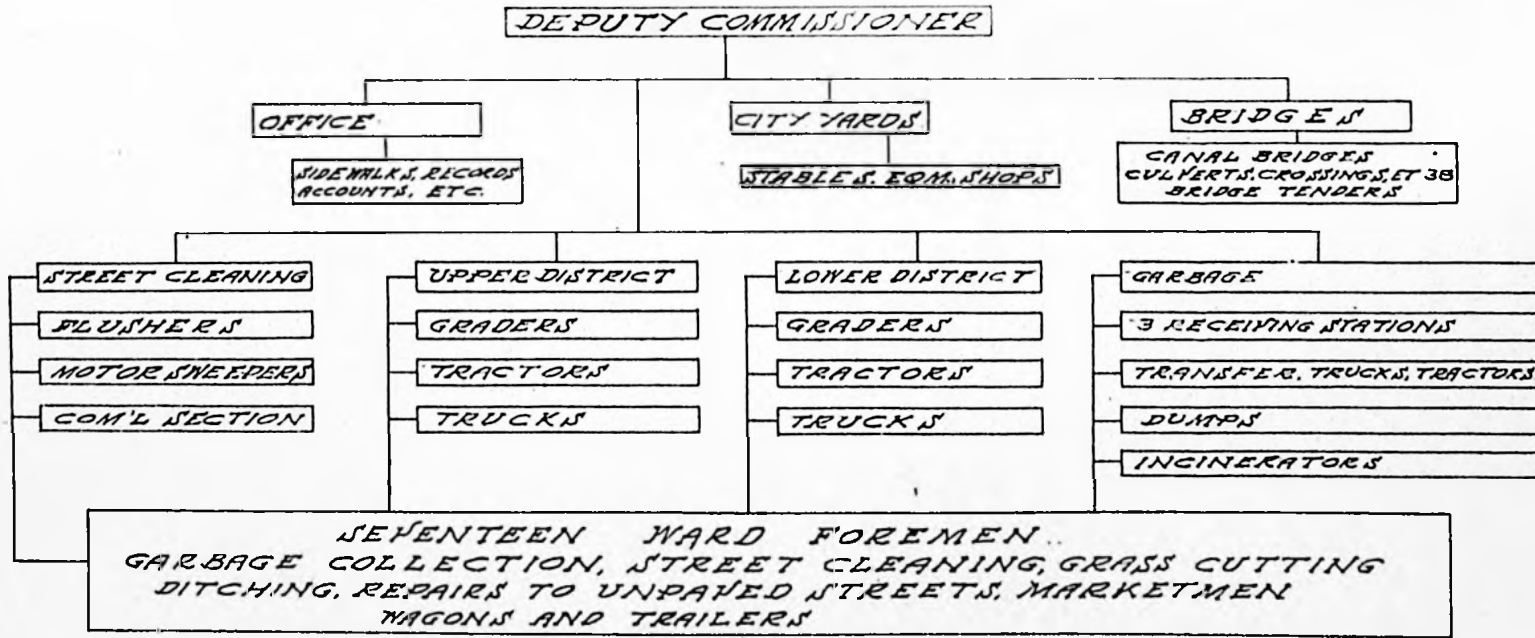
And now, what have I to offer as a substitute for the present plan of organization? Let me tell you quickly that you will not be entertained by a 20th Century Raphael Hythlodæ with an account of a new Utopia. I do not aim to copy after or emulate Col. Geo. Waring, whose wonderful principles of organization have stood the test of over 30 years in New York City. Further, no ideas to be presented are taken from the report on the survey of the city's affairs made in 1921 by the New York Bureau of Municipal Research. The present plan is patterned somewhat along the lines recommended in the Bureau's report. It would undoubtedly be both possible and profitable to apply certain principles from each of the foregoing references to any scheme of organization to be followed. We are concerned more with a comprehensive study of the whole than with particular study of details.

There are certain fundamental conditions to consider before launching forth the plan proposed.

The first is that there will be no changes in the functions of the divisions. Second, under the plan proposed, the same type of workmen will be employed. I am not going to raise any question about either of these premises. It is admitted that the constituted authorities have full power to make drastic changes in either, but in such case, the problem would take on an entirely different aspect.

Third, we must not forget the enormous area over which the activities of the division extend. This will not diminish, but on the contrary, in coming years, is certain to increase. Just remember, about 1000 miles are traversed by our garbage collection forces alone every day.

PROPOSED PLAN
ORGANIZATION CHART
DIVISION OF PUBLIC WORKS



Fourth, the volume of work to be done in nearly every class is subject to large variations. Grass is certain to grow in spring and summer, and leaves to fall in the autumn. Rain and watermelons will continue to be troublesome in garbage disposal. We cannot will these events not to happen; we must prepare for them.

The basic ideas, therefore, behind the plan which I propose are adequate, intelligent supervision, and flexibility to cope with seasonal variations in the work. The organization chart again speaks for itself.

I have added an entirely new section for bridges and have relieved the street superintendents of supervising this work. Many of the larger bridges have depreciated and fallen into disrepair to such an extent that this work should be handled vigorously by a supervisory officer, unencumbered with other duties.

The plan is a modified "ward system." Omitting the commercial section, where the unpaved street problems are not encountered, the forces throughout the remainder of the city engaged in street cleaning, garbage collection, grass cutting, ditching and unpaved street maintenance, would be summed up and reallocated by wards. A foreman, and one or two assistants, when necessary, would be in charge of all these activities in each ward. About 400 employees, or one-half the organization, will be affected, or will be answerable to the ward foremen. The superintendents of street cleaning, street repairs, and garbage, would have direct authority over the special equipment in their respective classes of work. Incidentally, it should be said that such equipment is actually insufficient to supply each ward with a single unit. The ward foremen would function as line officers and the superintendents partly as line and partly as staff officers. The activities pertaining to garbage disposal would remain as at present under control and supervision of the garbage superintendent. The grass section, as such, will disappear, and the work will be handled by ward foremen with their regular crews as the season demands.

It will readily be seen that the proposed plan will call for versatility in both the workmen and ward foremen. It will not be necessary, however, that every employee, answerable to a ward foreman, be proficient in each class of work. A large majority of the forces will continue to be greatly engaged on one line of work. None of the work calls for any great amount of skill.

The plan has for one of its objects the elimination of lost time as is at present experienced through task work. To give two examples:—Garbage collection is based on routes for each unit. When the route is collected, the day is ended for the collector. Except on Mondays and Saturdays, and according to season, this method often results in short days for the workmen and less to the city. It is true that some days are unusually long, but an analysis over a long period would undoubtedly show that the net result favors the workmen. In street cleaning, the condition is somewhat similar. The routes given to workmen for cleaning are usually covered before the day has passed, but only because the work has not been thoroughly done. The trouble here though lies in insufficient supervision. A street cleaning foreman, on foot, simply cannot cover the ground each day which his crews are supposed to clean.

Each ward foreman will have to be provided with an automobile, in order to function satisfactorily. One of his principal duties is to see that his forces put in full time, and only second in importance, he must see that the work has been properly done. Under the present plan superintendents are provided with machines and so are the garbage inspectors. The results are unsatisfactory because the territory to be supervised by each is too great for thorough inspection. The proposed plan provides for smaller areas to be supervised, but much more intense inspection. The ward foremen will have to be depended upon to see that their men are kept busy. Shifting of workmen from one job to another even in a different class of work will be necessary as occasions or the seasons demand. It is in this way that the plan proposed should provide much greater flexibility than is possible under the present plan.

It is very important that ward foremen be properly qualified. These men are the keystones of the structure. Previous experience as foremen is highly essential. Fortunately, as little skill is called for in the various classes of work, no previous training in such work is necessary. As the foremen will continually be in touch with the public, they must be diplomatic and intelligent. Other qualifications necessary would be a fair share of common sense, and determination to make a success of the work. Very often, foremen are more in sympathy with the workmen than with their employers, a condition which is fatal to any organization.

Job Analysis. I will not attempt to go into a discussion of the present methods of doing the various classes of work. While there is undoubtedly a great opportunity for improving the efficiency of the division through drastic changes in the methods of doing work, this problem should hardly be considered under the topic of "organization." Further, irrespective of the organization, studies of various methods can be made satisfactorily.

Costs. It should not be expected that the proposed plan would result in such efficiency that part of the budget will be returned to the city treasury. No matter what the organization, the demands for service will be much greater than can be met with full satisfaction. It is believed, however, that the proposed plan will permit greater accomplishment with the same funds than is obtained under the present plan. There will be an increase in the number of automobiles necessary. The number of supervisory officers under the proposed plan will be practically the same as under the present plan. However, somewhat higher salaries will be required for satisfactory ward foremen than are now paid the foremen who will be replaced. It will therefore be seen that the overhead expense of the proposed plan will be greater than that of the present. This greater overhead cost should be more than compensated for by the anticipated increase in the amount of work done.

Co-operation from the Public. In a general way it might be said that the bulk of the work of the division is caused by the forces of nature, and the waste and carelessness of the

public. The possibilities of reducing the amount of work to be done by the division merely by securing better co-operation from the public are so great, that a separate section might be established for selling the idea of prevention to the public through various media. The Division of Public Works might be called the city housekeeper, and as such, its principal function is that of cleaning. Obviously if the dirt is not caused, it will not have to be cleaned up. The individual little realizes that the nuisance he creates when throwing a piece of paper on the street is multiplied tremendously by others indulging the same practice.

If every householder should keep his own place clean, his sidewalk, and the gutter in front of his place, and if careless and deliberate littering of the streets would no longer prevail—imagine the results in eliminating work for the Division of Public Works! But this sounds too much like Utopia, and I said shortly after I started that we would not hear about such a place, so I had better stop.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of Special Meeting, Board of Direction, July 8, 1927

The meeting was called to order with President Lanphier in the chair, Messrs. Hamilton, Fey, Porter and Muth present.

The minutes of the previous meeting were read and approved and bills on hand were ordered paid, including the bill of Geo. E. Egdorf for refinishing the library room.

The ballots for new members were canvassed, there being 87 formal ballots and 4 informal ballots. On motion, duly seconded, the following members were elected:

Resident Members

Lewis R. Ferguson,
Arthur Wright Herbert,
Leroy M. Law,
Roger O. Wise,
Allen Ramsey Wurtele.

Transfer from Student to Resident Member

Edwin Essex Elam,
William Wallace Hay,
George P. Robbins, Jr.

There being no further business, the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Board of Direction, September 12, 1927

The meeting was called to order by President Lanphier, and the following members were present: Messrs. Todd, Fey, Moses and Muth.

The minutes of the previous meeting were read and approved and bills on hand were ordered paid.

The resignation of Mr. B. A. Ross was accepted with regret.

Letter of August 8th, from the American Engineering Council, was read, together with reply of the President.

Mr. E. S. Lanphier was elected delegate and Mr. John L. Porter as alternate to the American Engineering Council for the year 1928.

Letter of Mr. James M. Todd was read relative to offering Junior Memberships, and on motion duly seconded, the following resolution was adopted by the Board, with request that it be referred to the Society:

“Resolved, That the Louisiana Engineering Society offer two Junior memberships in this Society, one to Louisiana State University and one to Tulane University. The Junior membership is to carry with it the initiation fee and one year's dues. These prizes are to be awarded after the close of the ensuing school year to a Senior in engineering who will graduate in June. Inasmuch as the prize is to promote interest and enthusiasm in

the engineering profession, the Board requests that the award be based upon class standing, ability, character and personality, and that the award be made by a committee of each University composed of the Dean of the Engineering College and the Professors of civil engineering and mechanical engineering."

There being no further business, the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Society, September 12, 1927

The meeting was called to order about 8:10 p. m., Mr. E. S. Lauphler, President, in the chair, F. A. Muth, Secretary, and 46 members and guests present.

The minutes of the previous meeting were read and approved.

The report of the Committee on Refinishing the Library Room was made and the President called the attention of the members to the splendid appearance of the room and of the work of that committee. On motion, duly seconded, it was voted the approval of the members present.

Mr. Chester W. Carr read a most interesting paper on "Heating and Domestic Oil Burning." This was followed by a most interesting discussion. A rising vote of thanks was then tendered the speaker.

The meeting then adjourned to the usual collation.

F. A. MUTH, Secretary.



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PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

OCTOBER, 1927

"PATRONIZE OUR ADVERTISERS"

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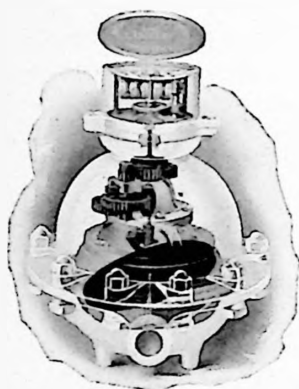
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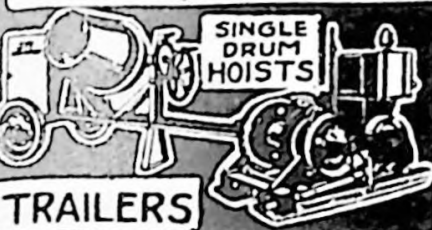
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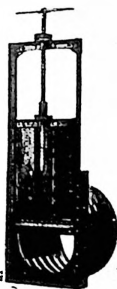
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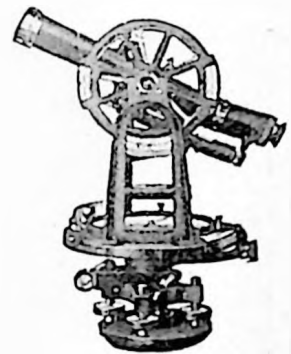
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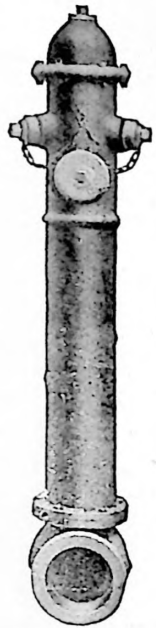
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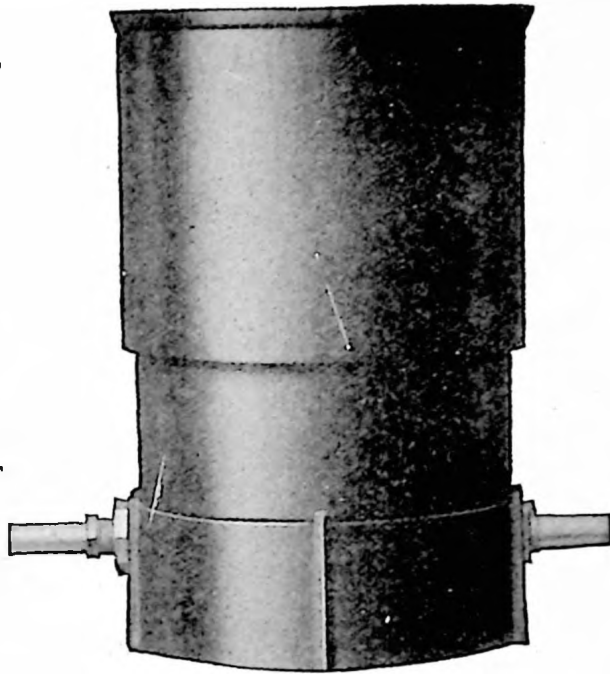
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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. XIII.

DECEMBER, 1927

No. 6

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EDITORIAL NOTES AND COMMENT

Pumping of Clay Slurry. The Louisiana Portland Cement Company has recently completed its big plant on the Industrial Canal. One of the materials under consideration for the making of the cement was the mud which accumulates in the bottom of the settling basins at the Purification Plant of the New Orleans Water Works. It appears that the Mississippi River silt, after the heavier sand and grit have been removed in the preliminary process of settling, and after the chemical treatment to which the water is subjected before the final settling, is found to be a very excellent material for the making of portland cement.

If this material was to be utilized by the Cement Company in its plant on the Industrial Canal, there was the problem of

its transportation over a distance of about nine miles, the yearly consumption amounting to approximately 60,000 tons of dry material.

The tests undertaken by Professor Gregory, the results of which are given in the paper published in this issue of the *Proceedings*, were for the purpose of determining the practicability of pumping this slurry through a 4-inch cast-iron pipe.

These experiments furnish valuable data on the friction losses, the best velocity for pumping and the viscosity of the slurries.

Professor Gregory's paper was published originally in the *Journal of the American Society of Mechanical Engineers*, and we are indebted to that journal for lending to the *Proceedings* the cuts which were made for the original publication.

November Meeting. In addition to the regular technical exercises at this meeting, the members of the Society were addressed by Mr. Henry W. Robinson on behalf of the Community Chest, appealing to them to assist in the drive for funds and to make their own contributions as liberal and as prompt as possible.

Through the courtesy of Mr. F. S. Reynauld, a very interesting film, called "The Story of Brass and Copper," was shown to the Society at this same meeting.

An Anniversary Meeting. The year 1928 marks the 30th anniversary of the organization and incorporation of the Louisiana Engineering Society. It was decided at the December meeting to celebrate this occasion in some manner, and a committee was appointed to take up the matter and decide upon the particular form the celebration should take.

While no official information has been given out, it is understood that plans are being made to hold a meeting at which brief addresses of a reminiscent character, dealing with the early beginnings of the Society and with the progress of the engineering profession during the past three decades.

It will be recalled that we still have upon our rolls as honorary members six of the men who signed the original

charter of the Society. In addition, there are a number of others who joined the Society during the very early years of its existence. All of these gentlemen have been intimately associated with the various phases of engineering activity in this city and community during the past thirty years, and there would seem to be no difficulty, therefore, in securing a good program for such an occasion as this.

New Members. The following men have recently been enrolled in the Society:

Resident Members.

Henry C. Daubert, Instructor in Applied Mathematics,
Delgado Trades School.
Reuben C. Gotch, Engineer with Ole K. Olsen.
Edward B. Ludwig, President, Canal Steel Works.
Earle B. Morden, District Manager, Foundation Co.
Corwin A. Robert, Civil Engineer and Surveyor.
Frederick B. Siems, U. S. Coast and Geodetic Survey.
B. E. M. Skerrett, Jr., Special Agent, Hartford Steam
Boiler Inspection and Insurance Co.

Non-Resident Members.

Charles D. Batson, 1001 Government St., Mobile, Ala.,
Republic Creosoting Co.
Stephen A. Eggleston, Carrollton, Miss., Mississippi
River Levee Engineer.
Ira G. Hedrick, Shreveport, La., President Ira G. Hedrick,
Inc., Shreveport, La.

Associate Member.

Frederick M. Strout, New Orleans, Sales Engineer.

Junior Members.

Wilmot A. Ackermann, Mississippi-Warrior Service.
Lionel J. Cucullu, Sewerage and Water Board.
Alvin A. Voss, New Orleans.

Transfer from Student to Resident Junior Member.

William L. Myers, Jr., Arkansas Highway Department.

Student Members.

Charles A. Bender, Jr.
Albert B. Davis, Jr.
Arthur A. De Fraites.
Newton C. Ebaugh.
George F. Eustis.
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Carl V. Lazarone.
Algernon A. Mabson.
Herman D. Mysing.
Rene H. Reixach.
George J. Segel.
Frank G. Stewart.

All Seniors in the College of Engineering, Tulane University.

Donation to the Library. Mr. W. L. Fey, Assistant Engineer of the Dock Board, has presented to the Library of the Society nine volumes (1916-1920) of the Proceedings of the American Institute of Electrical Engineers and two volumes of Hydro-Electric Power by Lyndon.

OBITUARY**JOHN DEVEREAUX O'REILLY**

After a short illness, John Devereaux O'Reilly, a member of this Society, died at his residence November 6th, 1927, as a result of complications which developed from a slight attack of influenza.

Mr. O'Reilly was born May 4th, 1884, in Denver, Colorado, and was the son of Frederica Devereaux and Anthony J. O'Reilly. He spent his early youth in Colorado, later moving to New Orleans, where he attended Tulane University. In 1904 he entered the Virginia Military Institute, from which he graduated in Civil Engineering in 1907.

Immediately after graduation he began his professional career as instrumentman on the Asheville to Henderson Interurban Railroad. Later he returned to New Orleans, where he engaged in the general practice of engineering. Perhaps he was best known through his service as Chief Engineer of the Board of Commissioners of the Port of New Orleans (Dock Board), which position he held from 1915 to 1919. During his tenure of office the Board engaged upon engineering works of more than ordinary character, among which were the Industrial Canal, embracing as it does the very large lock, built upon yielding soil, which together with its St. Claude Avenue Bridge, is numbered among the outstanding engineering achievements of the South. The Public Grain Elevator and other notable structures in the development of the Port were also completed during his service. During the World War, President Wilson appointed Mr. O'Reilly a member of the Council of National Defense of Washington, D. C. As a member of this Council one of his principal duties was the civil preparation and assistance in the

military defenses of the Harbor of New Orleans and other U. S. ports in the event of unforeseen enemy emergency.

With a change of administration Mr. O'Reilly returned to his private engineering practice and also engaged in engineering contracting in connection with highway work, pursuing this field of endeavor until his death.

Mr. O'Reilly was a man of extended acquaintance and his friends were by no means confined to the locality in which he lived. His personality was magnetic, particularly pleasing and affable, and there are many in all walks of life who will regard his death with a sincere sense of personal loss.

In addition to his membership in this Society and the American Society of Civil Engineers, Mr. O'Reilly was a member of the Delta Kappa Epsilon fraternity, the Louisiana Club and other organizations.

On June 30th, 1908, he married Miss Beatrice Gilmore, of this city, and to her and their children, Frederica, Eleanor, Beatrice, Charlotte and John Devereaux O'Reilly, Jr., we extend our sincere heartfelt sympathy.

In recognition of this loss which the Louisiana Engineering Society has sustained it is suggested that these remarks be spread upon the minutes of the society and a copy sent to Mrs. O'Reilly.

EDWARD S. BRES, *Chairman.*
DONALD DERICKSON,
WM. T. HOGG.

PAPERS AND DISCUSSIONS

THE PUMPING OF CLAY SLURRY THROUGH A FOUR-INCH PIPE

By W. B. GREGORY

Read before the Society, November 14, 1927

This paper gives the results of experiments in pumping a clay slurry, and the friction losses when pumping the material through a 4-inch cast-iron pipe.

The experiments were undertaken to help solve a practical problem for the Louisiana Portland Cement Company. This company is building a cement factory on the Industrial Canal in New Orleans. One possible source of raw material for making cement is the filtration plant of the New Orleans Water Works. Water is pumped from the Mississippi River into settling basins, where the heavier particles of sand and grit are accumulated. The water is next treated, receiving a certain amount of lime and iron, depending on its source and condition of turbidity. After flowing for about a mile through concrete passages, it is again placed in settling basins. The mud which accumulates in the bottom of these latter basins is found to be excellent material for making Portland cement. Sometimes it is of such chemical consistency that it needs no additional materials, but usually it is deficient in lime, which may be added in the form of ground shells.

It is about 45,500 feet from the filtration plant to the cement factory, and if it is finally decided to use this material, about 60,000 tons per year of dry material must be transported from one plant to the other.

It is not the author's purpose to discuss the entire problem involved, as this would necessitate going into the question of riding the slurry of water at one plant or the other, the economic limits of quantity of water in the slurry, etc.

The material accumulated in the grit reservoirs and the clay collected in the second set of basins were used for several years to fill vacant property belonging to the Sewerage and Water

Board, but is now pumped to the Mississippi River through an 18-inch main.

LAYOUT OF EXPERIMENTAL PLANT

On the 18-inch discharge main just referred to, a saddle was placed and a 4-inch. cast-iron pipe line was run down General Ogden street past the filtration plant to a vacant field where the mud could be discharged without inconvenience. The total length of this pipe was 369.75 feet. Gate valves placed near both ends of this pipe gave perfect control of the flow up to the pressure available in the 18-inch main.

Near the outer end of the 4-inch pipe there was a straight run of more than 200 feet, so that it was possible to obtain the difference in pressure in exactly 200 feet of pipe.

By means of elbows the pipe was conducted vertically, and at the top a short length of pipe attached to the riser by means of a loose elbow enabled the discharge to be shifted to either of two tanks, 5 feet in diameter and about 6 feet high, in which the volume of discharge was measured.

The mean areas of these tanks were found to be almost exactly the same, namely, 19.44 sq. ft. Large discharge valves near the bottom of the tanks enabled them to be emptied quickly. The 4-inch pipe was calipered before it was laid and found to be practically 4 inches in internal diameter.

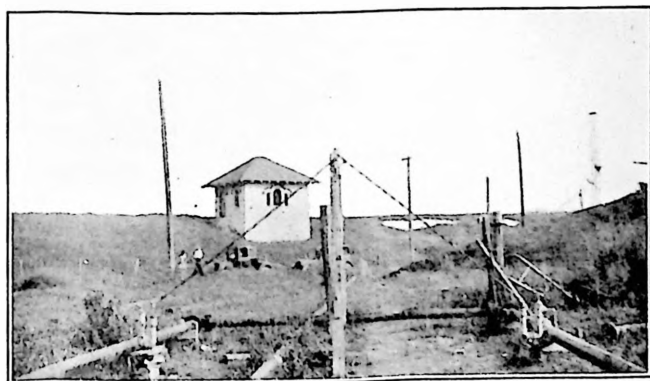
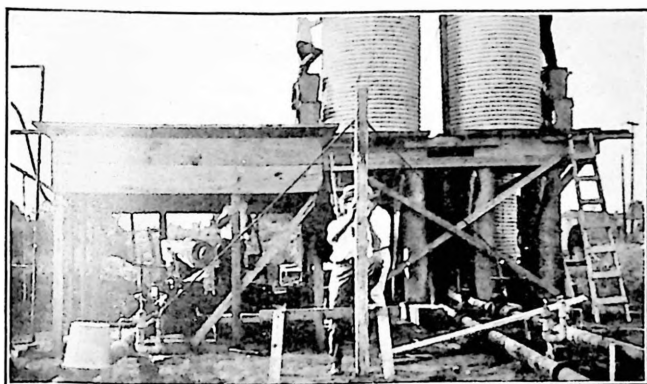
A measuring rod was provided that was divided into feet, tenths, and hundredths. The velocity in the 4-inch pipe was calculated from the volume in the measuring tanks by means of the formula

$$V = \frac{19.44 \times h'}{\text{seconds} \times 0.0872} = \frac{223 h'}{\text{seconds}}$$

where h' is the rise in feet during the observed time in seconds, and 0.0872 is the area of the 4-inch pipe in square feet.

The pressure drop in 200 feet of 4-inch pipe was measured by means of a mercury differential gage. Openings were made on top of the 4-inch pipe by drilling holes for $\frac{1}{4}$ -inch nipples, and $\frac{1}{4}$ -inch pipe was used to connect to a mud trap made up of 2-inch pipe fittings. A union was provided for quickly removing and cleaning the mud traps, and a stop valve was provided for shut-

ting off the pressure from the 4-inch pipe. From the top of the mud trap a blow-off valve was used to rid the connection of air, and from the other leg of the mud trap a $\frac{1}{4}$ -inch connection led to the mercury differential gage. Before each run the mud traps were removed, thoroughly washed, and filled with water. Before



FIGS. 1 AND 2 ARRANGEMENT OF MUD TRAPS

observations were taken, any air that had accumulated was blown out of the mud traps and from the top or both sides of the mercury differential gage. The arrangement of mud traps is clearly shows in Figs. 1 and 2, although the complete set-up as shown in these figures is to be described later.

A few measurements were taken with the set-up described above, and it was found that with clear water flowing through the pipe the losses were practically identical with those given in Williams and Hazen's Hydraulic Tables for the very best clean, new cast-iron pipe; the designation in their tables is in the column marked (00). These results are not given for the reason that the measurements were repeated with the later and more elaborate set-up, and results were obtained that were practically identical.

The experiments described above had to be made when the mud pump at the filtration plant was in operation, and the con-

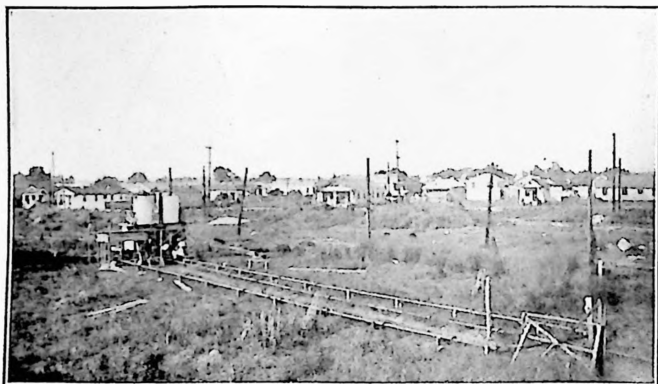


FIG. 3 LAYOUT OF EXPERIMENT

sistency of the material pumped was found to be quite variable. The head available to cause flow was also limited, and when the valves were wide open velocities below 7 feet per second were the highest obtainable. It was therefore decided that a new set-up could be better controlled.

FINAL LAYOUT OF EXPERIMENT

The 4-inch pipe from the discharge of the mud pump of the filtration plant was left as a supply pipe to a tank 12 feet in diameter and about 5 feet high. This tank could be filled at any time the mud pump was operating. It was provided with a discharge pipe which extended inside the tank, and had a swiveled

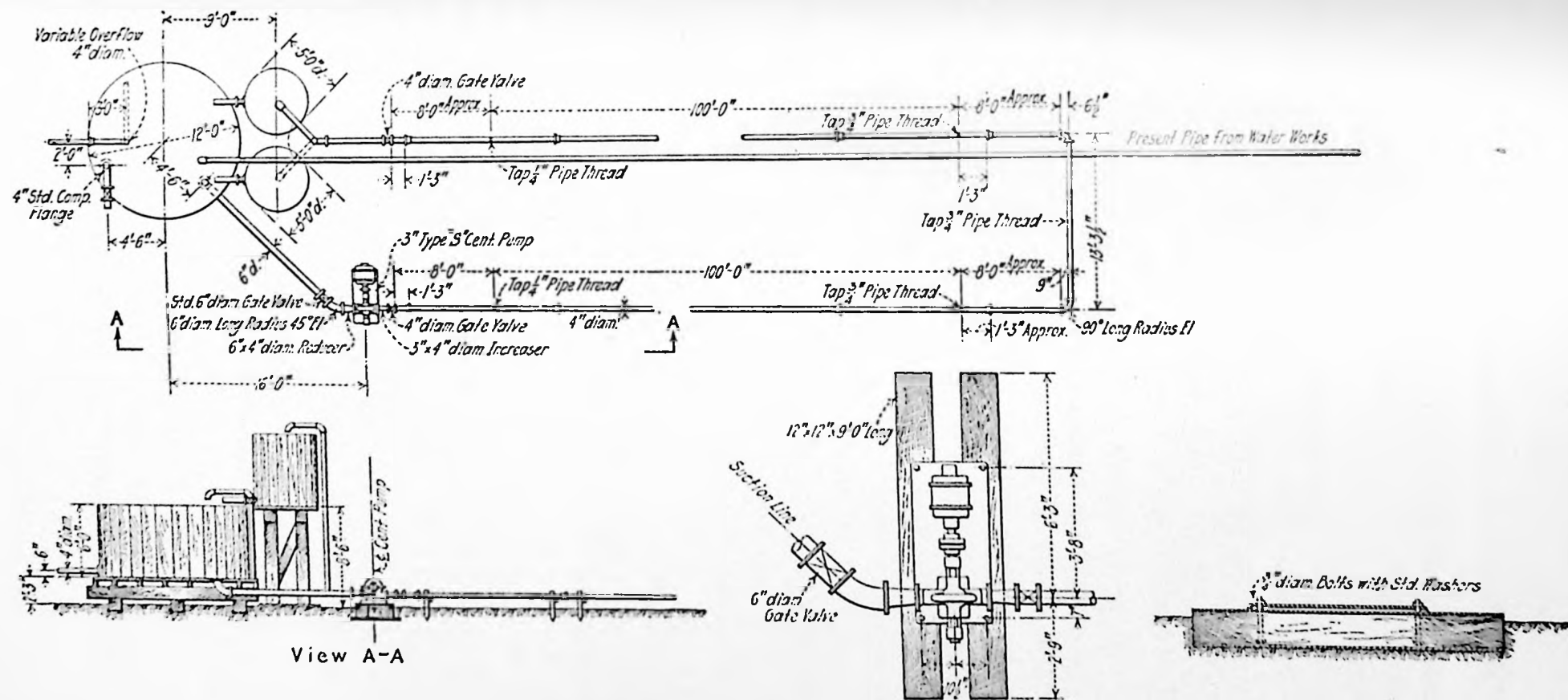


FIG. 4 DETAILED LAYOUT OF EXPERIMENT

elbow and pipe within the tank so that water collecting on the surface of the slurry could be skimmed off and allowed to flow from the tank.

To the bottom of the 12-foot tank was flanged the suction pipe leading to the centrifugal pump. The suction pipe was 6 inches in diameter and was provided with a 45-degree elbow and a gate valve. Beyond the gate valve was a cone reducer to 4-inch diameter at the suction of the pump.

The pump used was built by the Allis-Chalmers Company for Tulane University; its nominal capacity, when pumping water at 1750 r.p.m., is 300 gal. per min. at 45 ft. head on pump.

The pump is direct-connected to a 7½-hp. direct-current motor, and speed control is obtained by means of two rheostats. While the normal voltage is 115, it was found desirable to furnish a voltage of 220 on account of better speed control, as the variation of voltage was considerable due to external causes that could not be eliminated. Electrical energy was furnished by means of a cable from the filtration plant.

The suction of the pump was 4 in. in diameter and the discharge 3 in. The suction line from the tank was 6 in. in diameter. A reducer from 6 in. to 4 in. was used at the pump; back of the reducer was a 45-deg. elbow and beyond that a 6-in. gate valve. During these tests this valve was always wide open. Beyond the discharge flange a 3-in. by 4-in. expander was used, followed by a 4-in. gate valve flanged to the 4-in. pipe. Pressures were read at the pump by means of two calibrated bourbon pressure gages reading in feet of water. The gage on the suction pipe was connected to the middle of the reducer where the diameter was 5 in. The gage on the discharge was at the middle of the expander where the diameter was 3½ in.

The 4-in. cast-iron pipe extended out from the pump a distance of approximately 116 ft. to a 90-deg. flanged ell having a 9-in. radius, then across to another 90-deg. flanged ell having a radius of 6½ in., and then back to the measuring tanks. The layout is plainly shown in Figs. 3 and 4. The distance from center to center of the long pipes was 13 ft. 3½ in.

The arrangement was such that it was possible to tap the 4-in. pipe at points 100 ft. apart, and at a distance from the stop valve of the pump and the ells at the loop of about 8 ft. or $2\frac{1}{2}$ diameters. Then by connecting the two openings near the pump and the measuring tanks to a common mercury differential gage, the loss between these two points could be observed. By connecting the two openings near the loop to another mercury differential gage, the loss in the loop consisting of loss in straight pipe and elbows could be determined. The difference between these two sets of readings gave the loss in 200 ft. of straight pipe.

The measuring tanks were elevated to discharge into the large suction tank, so that material was not wasted but was pumped over and over again through the system of pipes and tanks.

THE MERCURY DIFFERENTIAL GAGES

The differential gages are plainly shown in Fig. 2. They have two glass columns side by side in an aluminum channel with iron fittings at top and bottom. Behind the glass tubes is an adjustable scale, graduated in inches and tenths, so constructed that it may be raised or lowered until the zero is at the height of the mercury column. Before starting a run the mud traps were taken off, thoroughly washed, and filled with clear water. The $\frac{1}{4}$ -in. iron pipes leading from the mud traps to the differential gage were then filled with water and connected, while the glass tubes above the mercury had previously been filled with water. Care was taken to remove air pockets, or, in other words, that the water columns were completely filled with water. The differences of height were read in inches and tenths of inches and reduced to feet of water by multiplying inches difference by 1.05. Since the specific gravity of mercury is 13.6 and that of water is unity, we have:

$$h = \frac{z(13.6 - 1)}{12} = z(1.05)$$

where h = head in feet of water and z = reading of differential gage in inches.

SCOPE OF THE EXPERIMENTS

While the primary reason for conducting the experiments was to study the losses in pipes when pumping clay slurry, it was

thought probable that the pumping, if done at all, would be accomplished by means of centrifugal pumps; and inasmuch as such a pump was used in the final experiment, it was thought worth while to conduct a test of the pumping plant. While some of the

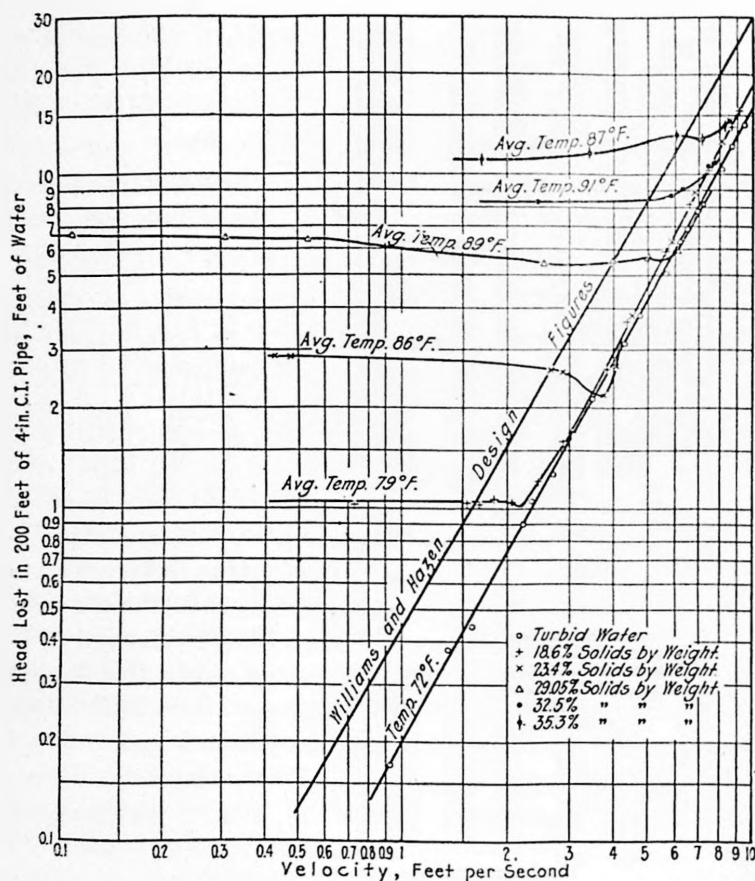


FIG. 5 RESULTS OF MAY AND JUNE EXPERIMENTS

results of the pump test were unsatisfactory, the results in general were of interest and of some value.

The results obtained from the experiments on the loss of head in pipes are, as far as the author is aware, the only data available in this problem.

METHODS OF CONDUCTING TESTS

The plan adopted in conducting the tests of May, June, and July was in general to take three sets of readings with conditions as constant as possible and to average the results. In the tests of November and December there were sufficient observers to take all observations simultaneously, and single observations were plotted. In general, the revolutions per minute were kept between the limits of 1600 and 1650, with an attempt to approximate 1625.

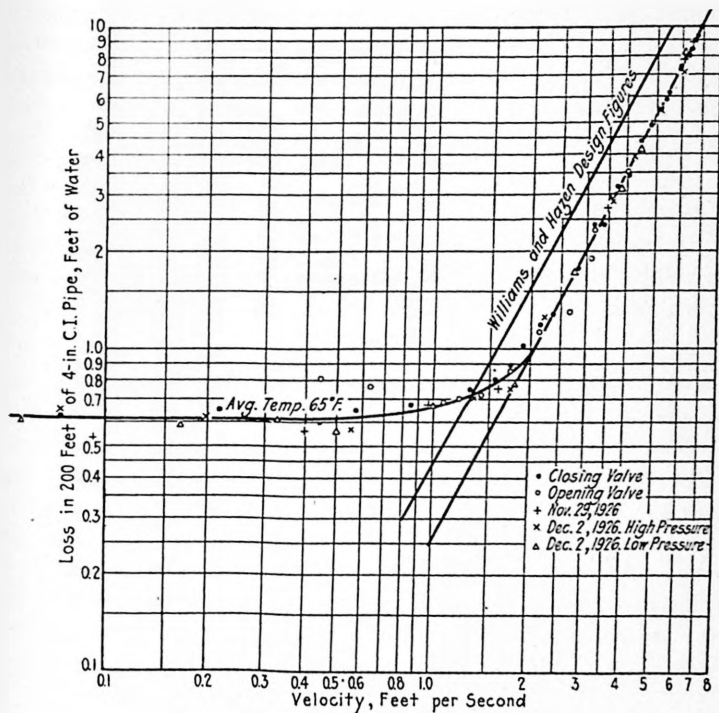


FIG. 6 RESULT OF NOVEMBER AND DECEMBER EXPERIMENTS

When conditions were satisfactory, observations were taken of time, r.p.m., amperes, volts, suction and discharge gages, the drop in pressure in 200 ft. of 4-in. pipe plus an additional length of 29.39 ft. of straight pipe and two ells, one having a radius of 9 in. and the other a radius of 6 in., and the drop in pressure in the

loop of shorter pipes and elbows. Temperatures of air and of material pumped were read from time to time.

The three observations for a given set of conditions were usually taken at about 5-minute intervals, and it was found that it required about that time to make the rounds and record the readings.

Meanwhile readings of quantity pumped were obtained in the smaller tanks. When a measurement of rise of level in the smaller tank had been completed and the time for the rise had been observed by means of a stop watch, the material was allowed to flow into the larger tank by opening the drain valves. A swinging pipe allowed the discharge to be turned into either of the smaller tanks. The velocity in the 4-in. pipe was obtained from the quantity-time observation as already explained.

At the end of a set of three observations the average velocity and the average loss in head in 200 ft. of pipe were computed. The results were then plotted on logarithmic paper so that any unusual conditions and the progress of the experiment could be noted.

The setting of the gate valves beyond the pump was then changed, the speed adjusted, and when conditions were constant and satisfactory another set of readings was obtained.

Before starting the observations when clay slurry was pumped a run was made pumping clear water. Perhaps it would be more exact to say turbid water, as it was obtained from the settling basins, but it was practically clear water. This was desirable as the losses when pumping water gave a standard with which the other results could be compared.

When this work had been completed the work on the clay slurry was begun. The record is as follows:

May 12-14, 1926. Made experiments with turbid water.

May 17, 1926. Material placed in experimental tanks.

May 20, 1926. First experiments with 18.6 per cent solids by weight.

May 22, 1926. Made experiments with 23.4 per cent solids by weight.

The slurry was then allowed to settle and surface water was drawn off. Some of the slurry was placed in an earthen reservoir where the water seeped into the soil, after which the slurry was returned to the experimental tanks.

June 1, 1926. Made experiments with 29.05 per cent solids by weight.

June 18, 1926. Made experiments with 32.5 per cent solids by weight.

July 8, 1926. Made experiments with 35.3 per cent solids by weight.

The results are shown in Fig. 5.

The later experiments of November and December were undertaken to settle more definitely the direction of the line for points below the critical velocity. The first set of tests had shown that losses below the critical velocity were practically independent of the velocity. To settle this point a new sample of slurry was obtained from the settling basins and experiments run as shown in Fig. 6.

The loss of head was read with a mercury differential gage as described above, but the low readings were from gages having water columns with air above the water, so that losses were read directly in feet of water. Samples of data as observed and computed are tabulated on the following pages.

THE MATERIAL PUMPED

The material pumped did not differ greatly from 15 per cent solids by weight as it comes from the reservoirs of the filtration plant. By allowing it to settle for several days and drawing the water off the top of the mixture, it may be concentrated to about 25 per cent solids by weight. To further remove the water by settling is a slow process, requiring considerable time.

PUMP TEST—CLAY SLURRY (23.4 PER CENT SOLIDS)

Time	R.p.m.	Amp.	Volts	Watts	Elec. hp.	Suction		Discharge		Head on pump ft.	V	Q G.p.m.	pump hp.	Effy., Per cent
						as read	corr.	as read	corr.					
10:00	1610	17.2	126.0	2170	2.90	3.2	3.9	55.7	57.3	53.4	0	0	0	0
10:28	1625	40.6	121.1	4930	6.60	1.0	1.7	35.9	37.4	36.9	8.12	317.0	2.95	44.6
10:50	1635	37.7	123.2	4550	6.23	2.3	3.0	39.5	40.5	38.3	6.81	266.0	2.57	41.2
11:08	1633	35.2	118.0	4150	5.56	2.1	2.8	43.2	44.5	42.0	5.82	228.0	2.41	43.3
11:25	1632	31.5	115.7	3640	4.89	2.4	3.1	48.6	50.0	47.3	4.54	177.5	2.11	43.2
1:00	1621	30.7	111.1	3410	4.57	2.9	3.6	48.3	49.5	46.2	4.06	159.0	1.85	40.4
1:20	1650	30.5	113.0	3440	4.61	2.8	3.5	50.5	51.7	48.5	3.78	148.0	1.80	39.1
1:40	1645	27.0	111.3	3010	4.04	2.8	3.5	53.7	54.9	51.6	2.89	113.0	1.47	36.3
1:57	1628	26.1	109.9	2860	3.84	2.7	3.4	53.6	55.0	51.8	2.67	104.5	1.36	35.4
2:16	1620	19.0	107.5	2040	2.74	3.0	3.7	54.9	56.2	52.5	0.48	18.8	0.25	9.1
2:33	1630	18.8	107.2	2020	2.71	3.1	3.8	54.1	55.5	47.9	0.43	16.8	0.20	7.5
3:07	1645	27.7	115.0	3180	4.27	2.7	3.4	55.7	57.5	54.3	3.15	123.0	1.68	39.4

PUMPING CLAY SLURRY (23.4 PER CENT SOLIDS)

No.	Time	R.p.m.	Amp.	Volts	Pressure, ft. of water		200 ft. plus		Diff.	in ft. of water	Discharge Rise in ft.	Sec.	Vel.	Temp.
					Suct.	Disch.	ells	Ells						
1	10:00	1610	17.2	126.0	3.2	55.7								
2	10:20	1631	41.0	122.8	1.0	36.8	15.40	3.00	12.40		1.58	42.8	8.23	88+
3	10:23	1615	40.5	120.0	1.0	35.5	14.55	2.75	11.80		1.56	42.8	8.13	
4	10:28	1630	40.2	120.5	1.0	35.5	14.38	2.75	11.63		2.14	59.8	7.99	
	Avg.	1625	40.6	121.1	1.0	35.9	14.78	3.83	11.94	12.54			8.12	
5	10:43	1625	37.5	128.5	2.5	39.1	10.40	2.00	8.40		1.31	42.8	6.82	82S
6	10:47	1630	37.8	121.0	2.2	39.5	10.65	2.15	8.50		1.30	43.0	6.75	80A
7	10:50	1650	37.8	120.0	2.0	39.9	10.65	2.15	8.50		1.39	45.2	6.87	
	Avg.	1635	37.7	123.2	2.3	39.5	10.57	2.10	8.47	8.89			6.81	

LOSS IN ELLS (23.4 PER CENT SOLIDS)

I	II	III	III minus II.	V
Loss in 200 ft.	$0.147 \times I$ Loss in pipe	Loss in ells and pipe	Loss in ells	
12.54	1.54	2.97	1.43	8.12
8.89	1.31	2.20	0.89	6.81
6.22	0.91	1.55	0.64	5.82
3.70	0.54	0.91	0.37	4.54
2.13	0.31	0.60	0.29	3.78
2.55	0.37	0.49	0.12	2.89

For the tests of May, June, and July the material tested was said to be a fair average sample, although it must be remembered that the Mississippi has many tributaries and at various times the waters from one of these sources may greatly exceed the normal flow from that stream, with corresponding changes in the nature

TABLE 1. DATA ON SLURRIES PUMPED

No.	Water		Solids		Weight of mixture, lb. per cu. ft. ¹	Specific gravity of mixture	
	Per cent by weight	Per cent by volume	Per cent by weight	Per cent by volume			
1	48.0	71.0	52.0	29.0	92.0	1.48	} Slurry pumped in May, June, and July
2	61.2	80.7	38.8	19.3	82.2	1.32	
3	69.0	85.5	31.0	14.5	77.1	1.24	
4	82.8	92.7	17.2	7.3	69.6	1.12	
5	88.2	95.2	11.8	4.8	67.2	1.08	} Slurry pumped in November and December
6	76.4	88.1	23.6	11.7	73.2	1.17	

¹ Weight of 1 cu. ft. of water at 85 deg. Fahr. = 62.2 lb.

of the material removed in the purification of the water. Not only is the original matter itself different, but the amount of lime and iron added will affect the material that is settled out after coagulation has taken place, as well as the semi-fluid matter surrounding the solids. An analysis of the sludge or slurry pumped in the tests of May, June, and July was made by J. L. Porter, Director of the Water Purification Department, New Orleans, La., and is reported as follows:

Herewith are presented the results of analysis of the sludge from Coagulating Reservoir No. 1, at the Carrollton Water Purification Plant, as used in the investigation of pipe-line flow and pumping conditions.

The sample taken was from the large tank at a time when the total solids had reached approximately 38 per cent by weight.

	Per cent
Loss at 106 deg. Cent. (water).....	61.97
Loss on ignition.....	4.25
Silica and insoluble silicates (clay and sand).....	23.40
Iron oxide and alumina.....	4.21
Calcium oxide.....	5.21
Magnesium oxide.....	0.76
Undetermined	0.20
	100.00
Carbonic Acid (CO ₂).....	4.01

Calculated to the dry basis the approximate analysis would be as follows:

	Per cent
Clay and sand.....	70.29
Carbonate of lime.....	23.96
Hydrate of magnesia.....	2.90
Hydrated oxide of iron.....	2.32
Undetermined	0.53
	100.00

This material contained a small amount of sand, which was not determined, but is included in the silica residue and classed with the clay.

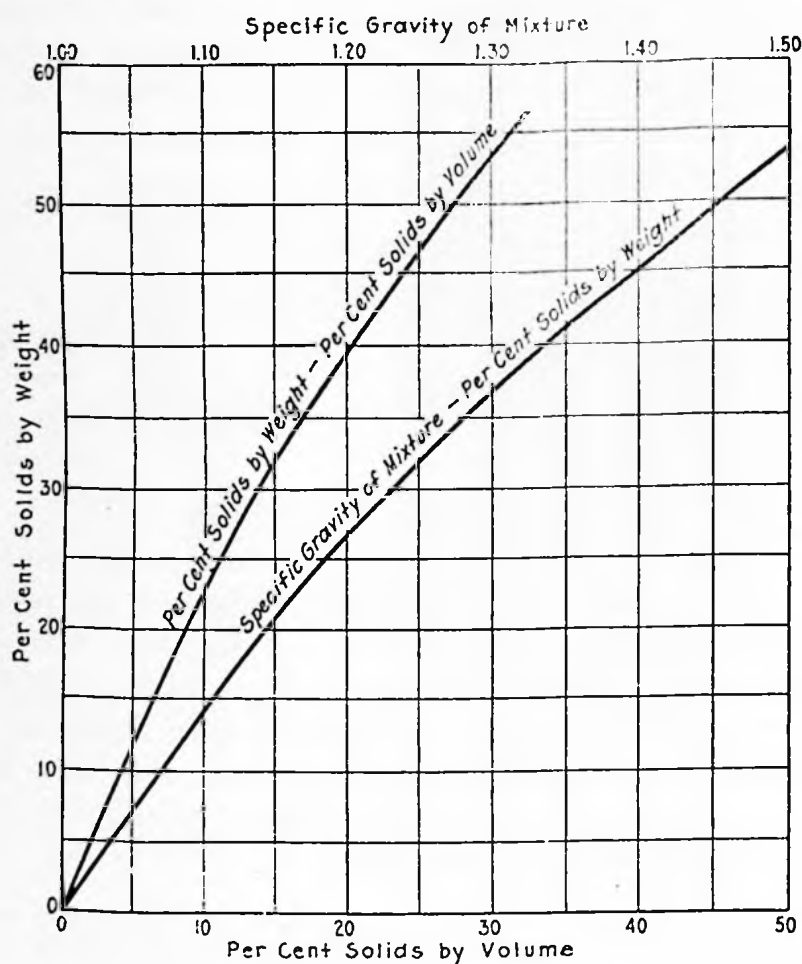


FIG. 7 DATA ON SLURRIES PUMPED

This shows a clay-lime ratio of approximately 3 to 1.

A sample of the wet slurry was taken on June 10, 1926, and evaporated to dryness at 212 deg. fahr. It showed 31 per cent solids by weight and 14.5 per cent by volume. Keeping the solids constant and varying the amount of water in the mixture, the values in Table 1 are obtained. Fig. 7 shows the more important relationships of Table 1.

The percentage of solids by weight is easily determined experimentally, while the percentage by volume required very careful handling. The solids present in samples Nos. 1 to 5 were found to have a specific gravity of 2.65, or a weight per cubic foot of 165 lb.

The weight per cubic foot of the slurry (No. 6 of the table) was 73.2 lb. and the specific gravity of the dry solid material was 2.38.

Under the microscope the material Nos. 1 to 5 had the appearance of minute crystals, a majority of which were of light yellow color, with a few darker and in some cases almost black. The material used in November and December appeared under the microscope to be composed of smaller particles quite uniform in color and size.

The experiments showed that the solids did not separate easily or quickly from the water, and that they did not cake in the pipe or stick to the pipe walls. After remaining in the pipe for several days, pumping can be resumed by applying a reasonable pressure to the pipe. A long pipe line with occasional connections to city water mains and convenient blow-out valves would meet the practical requirements of commercial pumping.

RESULTS OF EXPERIMENTS

Loss of Head in Pipes. Figs. 5 and 6 show the losses of head in 200 ft. of 4-in. cast-iron pipe measured in feet of water, plotted against velocity in feet per second; the first is for experiments of May, June, and July, while the second is for the tests of November and December. It will be noted that the results as shown when turbid water was flowing are on a straight line. As already stated, this line nearly agrees with the figures as given by Williams and Hazen in their Hydraulic Tables for 4-in. cast-iron pipe, clean, new, and laid perfectly straight, but the losses are slightly less.

The design figures recommended by Williams and Hazen are also given in the diagram as they do not mix with the other plotted results.

The slope of the line in the log plot for water is 1.90, and this is the value of n , the exponent of the velocity v in the formula $h = Kv^n$.

It should be noted that the experiments with water were not carried to a sufficiently low velocity to give viscous or non-turbulent flow. When the material contained solids by weight between 18.6 per cent and 35.3 per cent the log plot shows that a portion of the line substantially agreed with the line for water, indicating that turbulent flow was taking place. When the velocity was decreased to a certain value a region of critical velocity was encountered, while still further reduction of velocity shows practically constant loss of head.

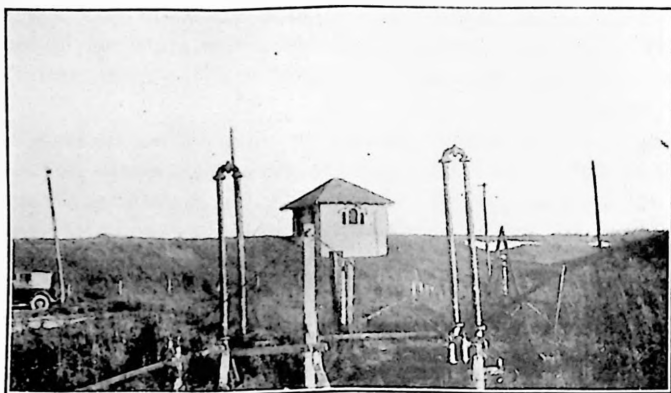


FIG. 8 SUBSTITUTED END LOOP OF PIPE

It will be noted that the three lower curves in Fig. 5 follow the line for water quite closely for some distance, while for the two upper curves they start near the line for water, but soon diverge from it, and as velocity is decreased soon became nearly horizontal. Two reasons account for this peculiarity. The material pumped was more concentrated than in the previous tests and the end loop of the pipe shown in Fig. 2 was replaced by that shown in Fig. 8, the latter having greater length and adding two 90-deg. elbows and two 180-deg. elbows in addition to those of the original loop.

Loss of Head in Elbows. The loss of head due to two elbows, one with $6\frac{1}{2}$ -in. radius and the other with 9-in. radius was determined; the results are given in Fig. 9.

The loop containing the elbows had 29.39 ft. of straight pipe, a part of which was cast iron and a part steel. Presumably the loss in this straight pipe is nearly the same per unit length as in the 200 ft. of cast-iron pipe. As the loss in 200 ft. was known from the experiments, it was assumed that the loss in 29.39 ft.

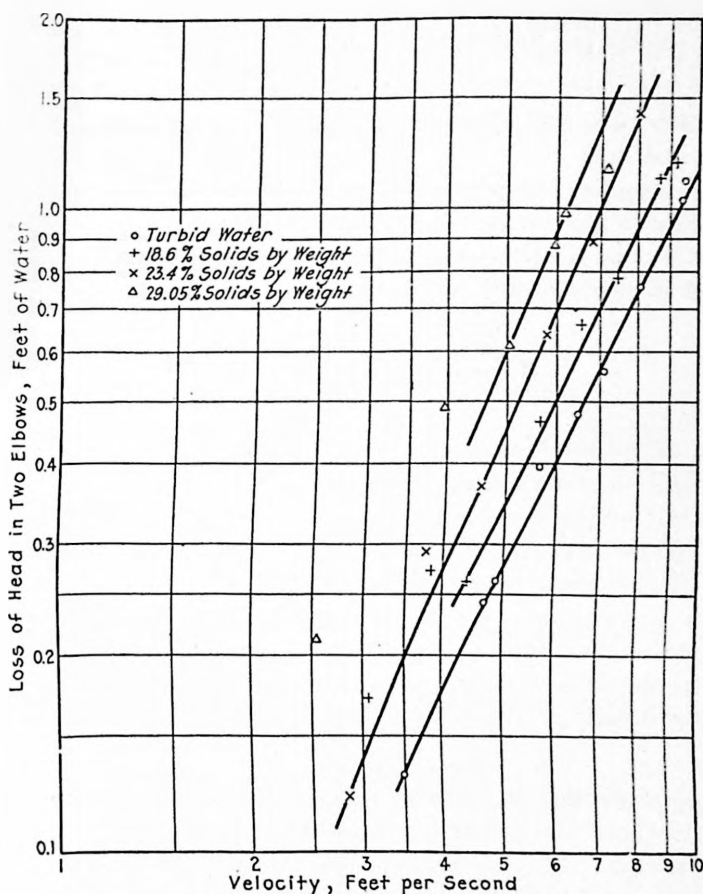


FIG. 9 LOSS OF HEAD IN TWO 4-IN. CAST-IRON ELLS
(One ell, 6 in. radius; one, 9 in.)

would be in proportion to its length or 0.147 times that of the longer pipe.

Now the loss in an elbow is not all in the length represented by the curve itself, for a loss is caused in the straight pipe beyond the elbow, and the pressure openings of the pipe were probably

far enough removed from the elbows to include the loss beyond them.

If from the actual loss observed the loss in the straight portion of pipe be subtracted, the difference should be the loss in the two elbows. As the loop was replaced after the third set of experiments with a double loop as shown in Fig. 8, no results were computed for the last four sets of readings.

THE PUMP TESTS

Pump tests are reported only for the experiments of May, June, and July.

The quantity pumped was known from the volume-time measurements in the tanks. The head on the pump was computed from the observed pressures on the suction and discharge sides of the pump corrected for velocity head.

$$H = h_d - h_s + \frac{V_d^2 - V_s^2}{2g}$$

where H = head on pump in feet of water

h_d = static head on discharge pipe

h_s = static head on suction pipe

V_d = mean velocity in discharge pipe

V_s = mean velocity in suction pipe

As the two gages were at the same level, there was no correction for height. Both read in feet of water.

The horsepower required to pump a fluid through a horizontal pipe, overcoming friction losses, may be expressed as follows:

$$\text{Hp.} = \frac{WH}{550} = \frac{Qw'h(w/w')}{550} = \frac{avhw}{550}$$

where W = pounds per second of the fluid pumped

H = total friction head in feet of fluid pumped

h = total friction head in feet of water

w = weight per cubic feet of water

w' = weight per cubic feet of fluid pumped

Q = quantity in cubic feet per second

a = area of pipe in square feet

v = mean velocity in pipe.

It is seen that this is independent of the density or specific gravity of the material pumped, so long as h is read in feet of water and not in feet of the material pumped.

The results of the pump tests are plotted in Figs. 10, 11, and 12. It should be noted in these sets of curves that there is a sagging in all three for 29.05 per cent solids by weight. Before this test was made the material was removed to an earthen reservoir. In putting it back into the experimental tanks, some foreign matter was carried with it in spite of considerable care. Strange

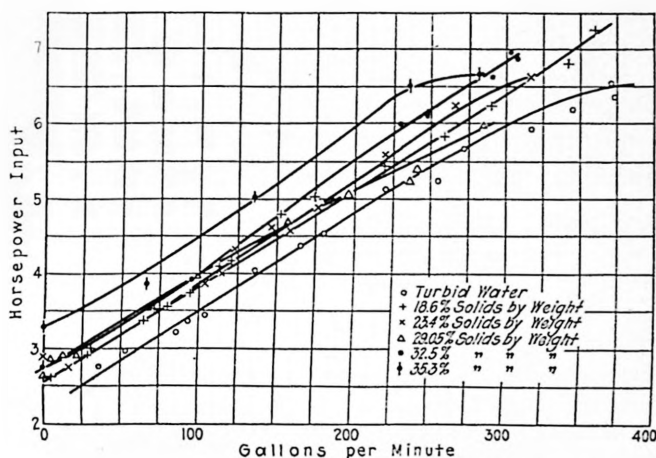


FIG. 10 RESULTS OF PUMP TESTS—HORSEPOWER INPUT AT VARIOUS LOADS

sounds developed in the pump during this test, and on taking it apart it was discovered that some of the passages of the pump at the entrance to the impeller were partially closed. The obstructions were removed before the last two experiments were made—with 32.5 and 35.3 per cent solids by weight.

It was very difficult to read the suction gage on the pump as the mixture became more concentrated and less fluid. The accuracy of the last two experiments, and especially the last one, is not as great as that of the others and easily accounts for the peculiarities of the curves.

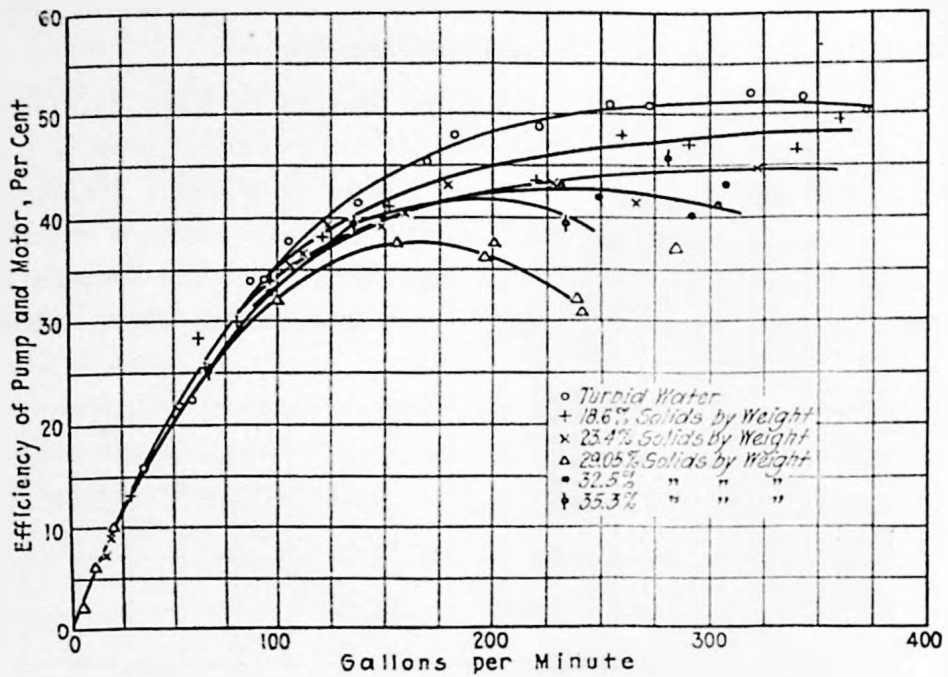


FIG. 11 RESULTS OF PUMP TESTS—EFFICIENCY OF PUMP AND MOTOR AT VARIOUS LOADS

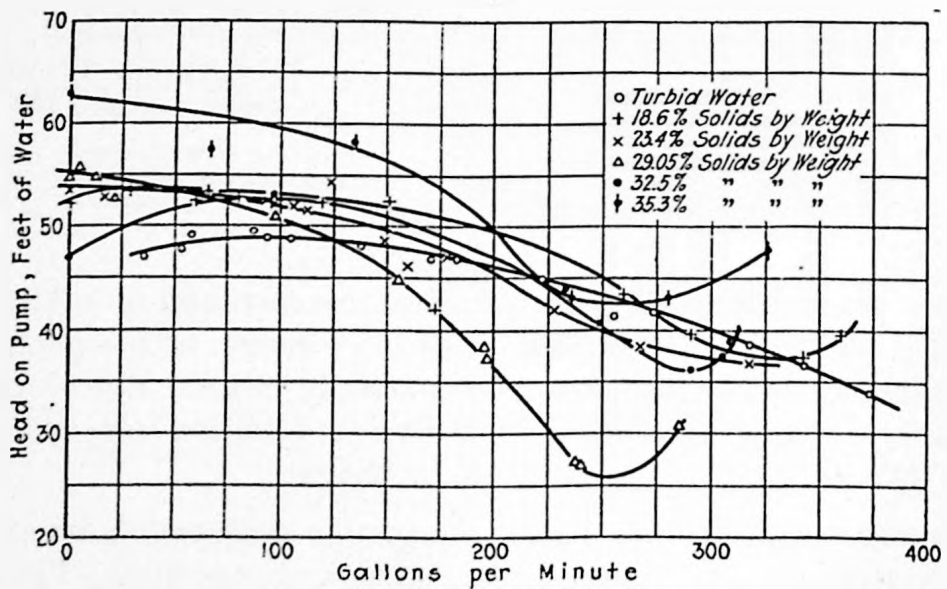


FIG. 12 RESULTS OF PUMP TESTS—HEAD ON PUMP AT VARIOUS LOADS

DISCUSSION OF RESULTS

An attempt to interpret the results of these experiments led to an inquiry as to the nature of the material pumped. When the flow through the pipe was turbulent it behaved very much like water, but below the critical velocity the behavior was most unusual inasmuch as the losses due to pipe friction were independent of the velocity. It is hoped that the discussion of the paper will bring out some ideas regarding the nature of the material and the reasons for the peculiarity of the friction loss.

The substance pumped has some of the properties of a viscous fluid and in other ways it behaves like a very plastic solid. It is composed of minute particles of solid material surrounded by a lubricating material consisting of water and some colloidal material (clay), with very little tendency for the solids to settle out. Certainly it obeys laws of viscosity very different from those of water. But there is a critical velocity which is the economical velocity for pumping.

VISCOUS FLOW

A fluid may flow in filaments that are parallel to the axis of the pipe, this phenomenon being known as viscous flow. When the velocity is increased so that there is considerable movement of particles from the inner surface of the pipe to the mass of fluid within, the flow is turbulent. The difference between these two sorts of flow was investigated by Osborne Reynolds, and his results were reported in the *Philosophical Transactions of the Royal Society* in 1883.

By using glass tubes and introducing aniline dyes, Reynolds was able to demonstrate experimentally the existence of these two forms of flow and to further show that the point of change from one form to the other depended on whether the change was from a high to a low velocity or from a low to a high. In other words, he found a zone of uncertainty where the velocity was either viscous or turbulent. Experiments with water made by Reynolds and many other investigators show that when viscous flow exists the loss of head is directly proportional to the velocity. On logarithmic paper this plots as a 45-deg. line. When turbulent flow takes place, the loss is proportional to a power of velocity that is usually less than 2; the figure 1.75 is sometimes given, while the

experiments with water reported in this paper give the slope of the line as 1.90.

Poiseuille, in 1842, experimented with the flow of liquids in capillary tubes. He wished to understand the flow of blood in veins and capillaries. His work was very well done, and the deduction of the mathematical laws on which they depend was quickly accomplished after the experimental results were available.

Poiseuille's law may be expressed by a formula in English units as follows:²

$$p = \frac{32uLV_c}{gd^2}$$

where p = pressure drop as lb. per sq. ft.

L = length of pipe in feet

V_c = average velocity of fluid at critical velocity

u = absolute viscosity in second-poundals per sq. ft.
= lb.-sec. per sq. ft.

g = acceleration due to gravity, ft. per sec. per sec.

d = diameter inside pipe in feet.

Viscosity is defined as the internal friction of a moving liquid. It is the force required to move a plane surface of one square area past another of large area at unit distance, at unit rate of speed, when the space between is filled with the viscous liquid. Many ways have been devised for measuring this force; as, for instance, by dragging a flat surface body through liquid and noting the pull required; however, the form of instrument most frequently used consists of a tube of small bore and relatively great length, through which the liquid is driven under a small head and at low velocity, so as to prevent eddying. Such an instrument is the Saybolt viscosimeter, used to determine the viscosity of oils. An attempt was made to determine the viscosity of the clay slurry of the experiments of May, June, and July by means of a Saybolt universal viscosimeter, but without success. With the materials of the later experiments—those of November and Decem-

² Principles of Chemical Engineering, by Walker, Lewis & McAdams, p. 76.

ber, 1926—it was possible to use the viscosimeter, and the following results were obtained:

Temperature of air and slurry, 72 to 74 (average 73) deg. fahr.

Time for 60 cc. to flow, 45 sec.

Further attempts were made to determine the viscosity of this material by Leon Lassen, working with another Saybolt standard viscosimeter, and with temperatures ranging from 43 to 126 deg. fahr. The results were somewhat discordant, but seemed to indicate that viscosity for this material was independent of temperature and the average time for 60 cc. of slurry to flow was about 48 sec.

This slurry differed from that experimented with in May, June, and July, in that it appeared to have smaller particles when seen under the microscope, and there was a great uniformity of size and color that was lacking in the earlier-tested material.

If the slurry is a viscous material, it should be possible to apply Poiseuille's law. Taking the equation that represents this law, it may be used to solve for u the absolute viscosity in these experiments at or below critical velocity.

This certainly can be done when the liquid is water or a viscous fluid like oil. With fine solid particles in suspension in a fluid there is some question as to whether it is a problem of viscosity or one of plasticity below the critical velocity. These experiments show that above the critical velocity the material behaves much like water and that there is turbulent flow.

Assuming that Poiseuille's law applies at the critical velocity, we have:

$$\begin{aligned}
 p &= \frac{32uLV_c}{gd^2} \\
 &= \text{pressure drop in pounds per square feet} \\
 &= 0.433 \times 144 h = 62.3h \\
 62.3h &= \frac{32u(200)(V_c)}{(32.16)(1/3)^2} \\
 u &= \frac{0.0348h}{V_c}
 \end{aligned}$$

Using the log plots, Figs. 5 and 6, we may now read off values of V_c the critical velocity and h the loss of head in 200 ft. of pipe in feet of water and compute u —see Table 2.

TABLE 2. VALUES OF CRITICAL VELOCITY, LOSS OF HEAD, FRICTION FACTOR, AND VISCOSITY

Number	Per cent solid by weight	Sp. gr. of slurry, S	Critical velocity, V_c	Loss of head in 200 ft. of water, h	Loss of head in feet of slurry, H	$\frac{V_c^2}{2g}$	Friction factor, f	Viscosity, μ
1	12.6	1.13	2.25	1.05	0.93	0.0787	0.0197	0.0162
2	23.4	1.175	3.60	2.60	2.21	0.2015	0.0183	0.0251
3	29.05	1.225	6.00	5.70	4.65	0.5598	0.0139	0.0331
4	32.5	1.255	7.00	9.60	7.65	0.7618	0.0167	0.0477
5	35.3	1.285	8.50	14.00	10.90	1.1230	0.0162	0.0572
6	23.6	1.17	1.5	0.77	0.658	0.0350	0.0312	0.0178
7	23.6	1.17	2.0	1.00	0.855	0.0622	0.0229	0.0174

The value of the friction factor f may also be computed at the critical velocity.

$$H = \frac{fL}{d} \frac{v^2}{2g} \quad \therefore \quad f = \frac{2gHd}{Lv^2}$$

If we assume at the critical velocity both Poiseuille's law for viscous flow and the ordinary law for loss of head due to turbulent flow apply, we may write

$$p = \frac{32uLV_c}{gd^2} = \frac{fwLV_c^2}{2gd}$$

From which we have $V_c = \frac{64u}{fw'd}$, where w' is the weight of the fluid in pounds per cubic feet; water at 68 deg. fahr. weighs 62.3 lb. per cu. ft.

If the viscosity u , the friction factor f for the pipe in question, and the weight per cubic foot of the fluid pumped w' are known, it is possible to compute V_c for any size of pipe required. This is important from the engineer's point of view, because it is desirable to pump the slurry at about the critical velocity. If the critical velocity is greatly exceeded, the head and the losses increase nearly as the square of the velocity for turbulent flow.

Since the absolute viscosity of water at 60 deg. fahr. is 0.000672 in English units, the viscosity of the slurry experimented with varies from 24 to 85 times that of water. It should be noted that the two samples of slurry pumped showed quite different values of f the friction factor and μ the viscosity. No doubt a large part of these differences was due to the nature of the material itself. The value of f was possibly increased for the tests of November and December because the pipe was several months older than in the tests of May, June, and July, and was not in as good alignment. The inner surface of the pipe had also doubtless changed somewhat due to rusting. However, all these reasons probably contribute but little to the increase of f .

The formula³ that is considered as applicable to viscous fluids to determine the critical velocity is

$$V_c = \frac{K\mu}{w'd}$$

It is seen that V_c is directly proportional to the viscosity μ , and inversely proportional to the weight per cubic foot of the material w' and to the diameter of the pipe d . The effect of density of the fluid and its relationship to viscosity is brought out in the statement—a condition “tending to stability and steadiness of motion” is a “reduced density of fluid.”⁴ These considerations are important and should be kept in mind in what follows, as points of variance with accepted viscous-flow formulas will be shown for the material under consideration.

The results of the experiments reported in this paper as shown in the above table of results, indicate that for this material the critical velocity is greater as the density is increased, which is exactly the opposite of statement of the above formula. It is therefore questionable whether the viscosity μ can be found by the methods that have been used in computing the table. The question arises, Has the slurry a viscosity comparable to homogeneous fluids, such as water and oil, for which the formula was

³ Principles of Chemical Engineering, Walker, Lewis & McAdams, p. 76.

⁴ Hydraulics, Gibson, p. 43.

derived? Leaving this question unsettled for the moment, let us examine the first formula for viscous flow:

$$p = \frac{32uLV}{gd^3}$$

The pressure drop is directly proportional to the velocity and to the viscosity u . Comparing this formula with the experimental results, it is seen that in the latter the loss of head below the critical velocity does not increase with the velocity V but, on the contrary, it even decreases slightly with V in some cases; in general, however, it may be said to be independent of V . The results show a failure to conform to the formula, and point to the advisability of not considering the flow of the slurry as similar to that of homogeneous liquids.

In the viscous flow of a liquid within a pipe at constant temperature it has been assumed that the velocity increases from a value of zero at the wall of the pipe to a maximum velocity at the axis; that particles of fluid travel in straight lines parallel to the axis, and that there is no radial component of the velocity. In other words, it is assumed that there is no mixing of the various concentric layers of liquid which are slipping by one another.⁵ Experiments made with colored water injected into a stream of water flowing in glass tubes have demonstrated that the above assumption is substantially correct.

When the nature of the material used in the experiments of this paper is investigated, it becomes obvious that it is not truly viscous as is oil or water. The slurry, as already noted, consists of solid particles suspended in a liquid. These particles vary in size from that which is considered as colloidal to large microscopically visible particles. If it is assumed that the flow occurs in concentric layers it must be considered that the resistance to flow is due to the shear of adjacent layers or to a displacement of solid particles within the layers. In pure viscous flow the shear is due to the viscous resistance between layers only, while in the flow of slurry the cohesion of the liquid becomes but a part of the total resistance, for the layer is made up of a suspension

⁵ *The Flow of Liquids*, by W. H. McAdams, Bulletin Mass. Inst. of Technology, vol. 60, no. 65.

of solid particles which interlock within and between layers, tending to increase the resistance to shear to such an extent that the cohesive resistance becomes but one factor. It is not intended to imply that the viscous resistance of the liquid is absent, but to emphasize the fact that the resistance due to the presence of the solids is of great importance.

If the viscous resistance of the liquid varies as in water, oil, and air, the losses vary directly with the velocity and it follows that the resistance due to the presence of the solids must vary in some opposite way so that the sum of the two is constant below critical velocity.

It may also be assumed that each layer contains the same number of particles at the beginning of flow as at the critical velocity, so that each layer, and hence the entire body of slurry, must have a starting resistance. This helps to explain the extraordinary fact that slurry shows practically the same loss at extremely low velocity as with velocities that approach the zone of critical velocity.

From the above hypothesis it may be expected that with an increase of concentration of solid particles the starting resistance will increase, also that with equal concentration a suspension of a finer material will have a smaller starting resistance and hence a lower critical velocity. From the curves presented in this paper it will be seen that the above corollaries are in accordance with the experimental facts, for with a greater concentration of particles the critical velocity is increased. Also, comparing Experiment No. 2 with Nos. 6 and 7 in Table 1, it is seen that although of approximately equal concentrations and specific gravity, the critical velocity of the latter is lower than the former.

Microscopic examination of the first slurry experimented with showed that the particles were unequal in size, were rough and generally larger than in the second sample, which was composed of particles very uniform in size as well as smaller. This also agrees with the second assumption.

It is of interest to note that the value of the friction factor f as computed at the critical velocity was less for Experiment No. 2 of the table, while the viscosity was considerably more than for Nos. 6 and 7. The value of f should vary directly as the density

or specific gravity and inversely as the viscosity. It will be seen by comparing No. 2 with Nos. 6 and 7, that the indications are that the variations are in the right direction and roughly proportional.

CONCLUSIONS

1. The material can be pumped: the engineering problems involved in pumping are simple.
2. The most economical velocity for pumping is at the critical velocity.
3. The apparent viscosity of the slurry at the critical velocity varied from 24 to 85 times that of water, depending on the amount of solids presented in the slurry.

The author wishes to express his indebtedness to the Louisiana Portland Cement Company, and especially to Messrs. A. D. Stancliff, Superintendent of the New Orleans plant, John L. Porter, Director of the Water Purification Plant, for valuable advice and coöperation, and Leon Lassen, Assistant Engineer, for assistance in the experimental work and in the preparation of this paper. Thanks are due also to Prof. J. M. Robert and the Senior Class of the College of Engineering, Tulane University, for help in taking observations.

Discussion

MR. LANPHIER: Gentlemen, the paper is now open for discussion, and if you want any further information, I am sure Prof. Gregory can give it, and no one has the temerity to doubt his conclusions. The matter is now open. Does Mr. Porter wish to have anything to say from his end, as to his experience?

MR. PORTER: I have very little to say, except possibly to add the fact that about three weeks ago we had occasion to run a test on our main pumping outfit, used for pumping mud to the river. Due to the amount of mud in the reservoirs we were able to get material with a specific gravity of 1.17 for one test, which was comparable to that used in the test on the 4-inch line, and the results of the test on the 18-inch line indicated a very close agreement with the corresponding tests made on the 4-inch line. Furthermore, I was interested to see just how the increased horsepower required for pumping mud would compare with the data

given in the handbooks. They give the rule that the water horsepower of the pump should be increased over that required to pump water, for the same water head, by a percentage equal to the specific gravity increase. In other words, with a fluid having a specific gravity of 1.17, the horsepower required would be seventeen per cent greater than that required to pump water. On a series of tests which we made with a Wood Trash pump, with 18-inch line, pumping slurry weighing say 73.5 pounds per cubic foot, specific gravity 1.17, the increase in horsepower would be 17.10. I then went over the tests on the 4-inch line and worked out the corresponding figures. The nearest one we had to compare on that was with a specific gravity of 1.12, and the horsepower increase in that case averaged 7.4 against 12 per cent as given in the handbook.

It would seem perhaps that the coefficient of friction which is greater in a small pipe than in a large pipe, would make the horsepower required for the mud itself a smaller percentage of water horsepower than in the case of the large pipe.

The kind or character of the material which is pumped, seems to me to be one of the very important items to be considered in any work of this character; the difference in results obtained, as pointed out by Prof. Gregory, between material pumped during the early summer and material pumped along in November, where materials having the same percentage of solids gave quite different results, is to be accounted for by the quality of the material.

The slurry handled is a mixture of clay, which is more or less colloidal, with the precipitates which are the result of the chemical treatment. The lime, white, crystalline in character, would probably produce a greater friction loss than the clay itself, and under conditions where the lime percentage is greater due to the treatment used, a greater horsepower would be required for pumping for a given percentage of solids than where the percentage of lime precipitate in the slurry is lower.

MR. LEHDE: How many tons of mud are required for a ton of cement?

PROF. GREGORY: Are there any cement people here this evening, who can answer that question. Mr. Porter may be able to tell you about that.

MR. PORTER: I think roughly half as much clay as cement to be made.

PROF. STEINMEYER: We are constantly pumping a fluid containing a large percentage of solid material through our pumps, but there is a constant replacement of the cylinder linings due to the fact that this material contains small portions of sand.

PROF. GREGORY: We had our pump apart on several occasions and it showed practically no wear. You must remember that the time consumed in these experiments represented only a few hours, possibly two or three days pumping; pumping through it for six months might be another story. However, I think the pump held out very well and showed very little abrasion.

MR. SREINMAYER: I know our pumps lasted only about four months. With constant and steady pumping it was necessary to replace them.

MR. PORTER: We have been using one pump on this work for about eleven years. The particular material with which we made these experiments was a good material, such as cement companies are interested in, and contained practically no hard grit. This was principally clay with a very small amount of extremely fine sand, and it probably flowed so smoothly that there was no abrasion produced by it; but our big pump is used to pump material containing, at times, considerable sand and grit, and shows very little wear as yet.

MR. LEHDE: Have any conclusions been reached regarding pumping this mud, figured on the investment?

PROF. GREGORY: Mr. Porter did some work on that and he may be willing to tell you about them.

MR. PORTER: I only worked these figures out for a preliminary study of the problem before Prof. Gregory made these tests. I figured the horsepower required, which checked very closely with Prof. Gregory's figures. The pumping cost figured out somewhere in the neighborhood of forty cents per ton. Those were only roughly approximate figures, without any storage charges added.

MR. LEHDE: Did it prove at that time to be worth while?

MR. PORTER: There are many factors involved, and I don't think the company has come to any decision on it.

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY.

Minutes of Board of Direction, October 10, 1927.

The meeting was called to order by President Lanphier, and the following members were present: Messrs. Hamilton, Porter, Fey, Todd, Moses and Muth.

The minutes of previous meeting were read and approved and bills on hand were ordered paid.

The following members were removed from the roll with regret: Messrs. M. F. Hunt, A. M. Hill, W. O. Mascaro, J. N. Ball, Jr., A. A. Lannaux, and W. J. Amoss.

The following members were reinstated: Messrs. P. Lehde, J. F. Thomson and F. J. Trelease.

There being no further business the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of Regular Meeting of the Society, October 10, 1927.

The meeting was called to order with President Lanphier in the chair, F. A. Muth, Secretary, and 63 members and guests present.

The minutes of the previous meeting were read and approved.

This being a joint meeting with the Local Section of the American Society of Mechanical Engineers, it was turned over to Mr. James M. Todd, Chairman of the Local Section.

Owing to the illness of the speaker of the evening, Mr. Carl Schneider, his paper on "A Reorganization Plan for the Division of Public Works of New Orleans" was read by Mr. Bryson Vallas, City Engineer. Some discussion followed this interesting paper which had been illustrated with charts. A rising vote of thanks was then tendered Mr. Schneider for his paper and to Mr. Vallas for reading it.

The meeting then adjourned to the collation.

F. A. MUTH, Secretary.

Minutes of the Board of Direction, November 14, 1927.

The meeting was called to order by President Lanphier, and the following members were present: Messrs. Hamilton, Fey, Todd, Porter, Fox and Muth.

The Minutes of the previous meeting were read and approved and bills on hand were ordered paid.

Announcement was made of the death of Mr. J. Devereaux O'Reilly, and the President was authorized to appoint a committee to draft suitable resolutions. The following committee was appointed:

Mr. E. S. Bres, Chairman.

Prof. D. Derickson.

Mr. W. T. Hogg.

Letter from the Western Society of Engineers relative to reciprocal membership was read and the President was authorized to appoint a committee of three members to study the matter and make recommendations to the Board relative to amending the Constitution of the Louisiana Engineering Society. The following committee was appointed:

Mr. John L. Porter, Chairman.
Mr. F. P. Hamilton.
Mr. James M. Todd.

Mr. W. J. Amoss was reinstated.

The name of Earle A. Berry was dropped with regret.

Letter from the American Engineering Council relative to celebration of the two-hundredth anniversary of the birth of George Washington in 1932 was read and the Secretary was instructed as to reply to be made.

On motion, duly seconded, it was voted that the Chairman of the Committee on Technical Papers be authorized to include any necessary expenses in the entertainment of out-of-town speakers when such expenses are proper in connection with the entertainment of the visitors while in the city.

Owing to the unnecessary surplus which has accumulated in the following funds, the Secretary was instructed to make the proper entry transferring to the General Fund the following amounts:

From the Proceedings Reserve Fund to the General Fund.....\$700.00

From the Library Fund to the General Reserve Fund..... 300.00

The Secretary was instructed to secure from Colonel Garsaud, Chairman of the Committee on Registration of Engineers and Architects, a report relative to the status of the work that the committee has been doing.

There being no further business, the meeting adjourned.

F. A. MUTH, Secretary.

Minutes of the Regular Meeting of the Society, November 14, 1927.

The meeting was called to order with President Lanphier in the chair, F. A. Muth, Secretary, and 65 members and guests present.

The minutes of the previous meeting were read and approved.

Mr. Henry W. Robinson, Vice-President of the Professional Organizations, Community Chest, made an appeal to the engineers to assist in the Community Chest Drive.

An interesting film of the "Story of Brass and Copper" was shown through the courtesy of Mr. F. S. Reynauld.

The technical exercises of the evening consisted of an instructive paper on "The Pumping of Mud Slurry Through a Four-Inch Pipe" by Professor W. B. Gregory. The paper was illustrated with slides. An interesting discussion followed and a rising vote of thanks was then tendered the speaker.

The meeting adjourned to the usual collation.

F. A. MUTH, Secretary.

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

DECEMBER, 1927

"PATRONIZE OUR ADVERTISERS"

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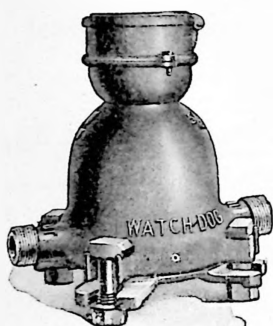
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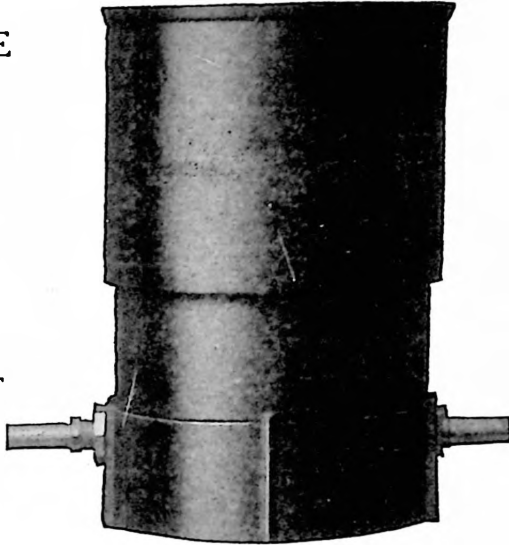
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